Construction Methods and Equipment

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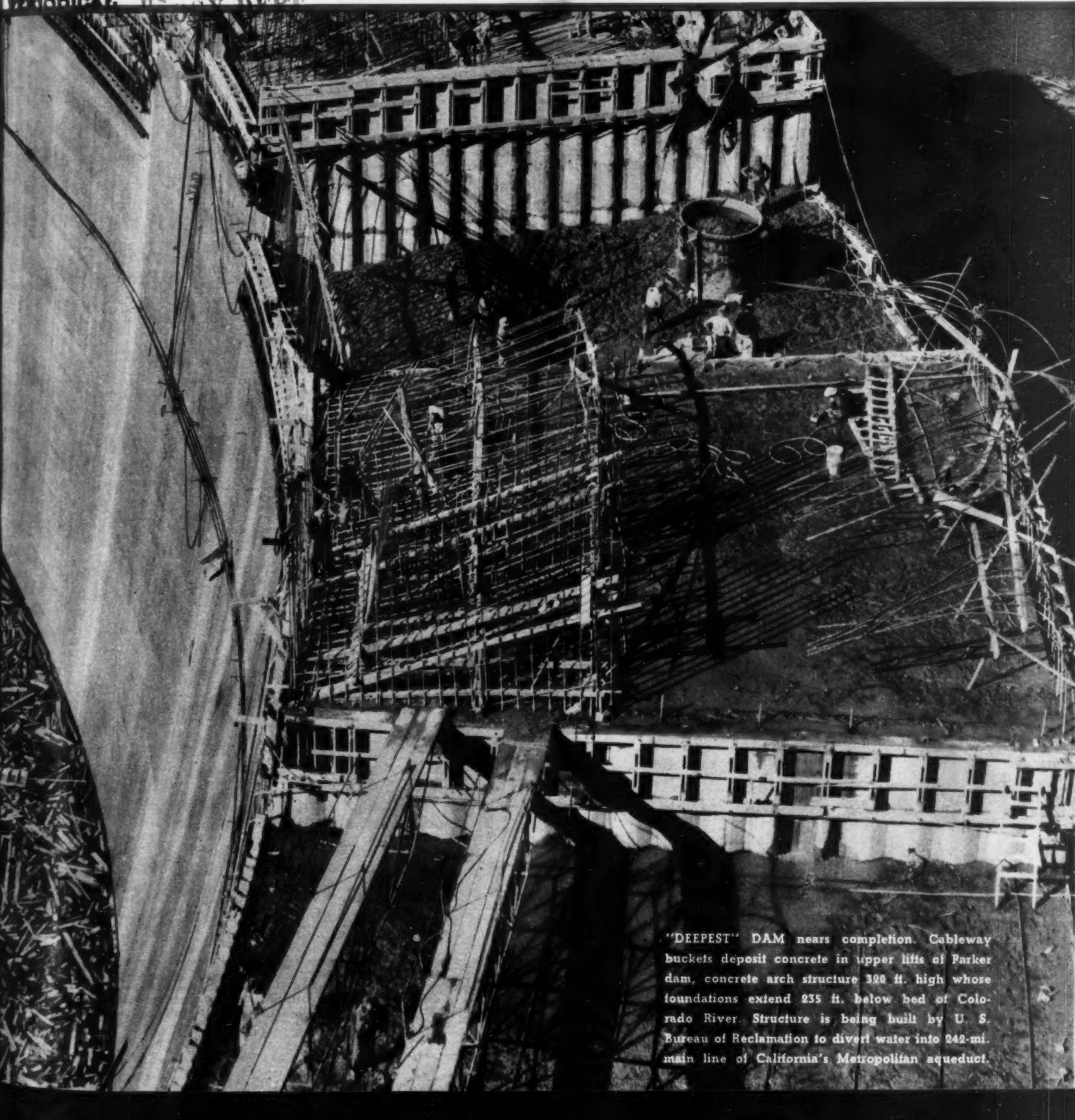

"DEEPEST" DAM nears completion. Cableway buckets deposit concrete in upper lifts of Parker dam, concrete arch structure 320 ft. high whose foundations extend 235 ft. below bed of Colorado River. Structure is being built by U. S. Bureau of Reclamation to divert water into 242-mi. main line of California's Metropolitan aqueduct.

CURRENT JOBS

. . . . and Who's Doing Them

DAMS AND WATERWAYS

Low bidder for the 560 ft. high Shasta dam, main construction feature of the U. S. Bureau of Reclamation's Central Valley project in California, was **Pacific Constructors, Inc.,** of Los Angeles, with a tender of $35,939,450 for a structure that will contain 5,610,-000 cu.yd. of concrete; stockholders of Pacific Constructors, Inc., include **Griffith Co.; Metropolitan Construction Co.; Lawler & Maguire; Arundel Corp.; American Concrete & Steel Pipe Co.; Foley Bros.; D. W. Thurston; Shofner, Gordon & Hinman; W. E. Callahan Co.** and **Gunther-Shirley Co.; A. Guthrie & Co.; L. E. Dixon Co.;** and **Hunkin-Conkey Co.**

From **Morrison-Knudsen Co.,** of Boise, Idaho, Central Nebraska Public Power & Irrigation Dist. received bid of $1,-091,849 for section of supply canal. In Arizona, **Rohl-Connolly Co.,** of Los Angeles, with a price of $1,890,407 was low bidder on the Head Gate Rock dam, a rolled earth fill, for the U. S. Indian Irrigation Service. For riprap, bulkhead and hydraulic fill at Fort Hamilton Park, Brooklyn, N. Y., low bid of $844,656 was received from **Clemente Stone & Foundation Corp.,** and **Deliso Construction Co., Inc.,** of New York City. Contract amounting to $428,612 was awarded to **Kerns Construction Co.,** of Omaha, Neb., for canals for Central Nebraska Public Power Irrigation Dist. **J. Rich Steers,** of New York City, will build for $234,000 a steel sheetpile bulkhead at Bowery Bay, North Beach, N. Y. For dredging in Outer Harbor, Los Angeles, Calif., **Case Construction Co.,** of San Pedro, received a $259,120 contract.

WATERWORKS

State Water Resources Board, of New Hampshire, has selected **B. Perini & Sons, Inc.,** of Framingham, Mass., to build a dam and reservoir at Pittsburg and Clarksville, N. H., for $1,168,925. At Kansas City, Mo., **Boyle-Pryor Construction Co.,** local contractors, will build a $209,458 underground reservoir.

The "How" of it

For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

●

Construction Methods and Equipment

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H. W. CLARKE, Vice-President

JULY, 1938

ROBERT K. TOMLIN, Editor
A. E. PAXTON, Manager

Editorial Staff: Vincent B. Smith, Paul Wooton (Washington), Nelle Fitzgerald

BUILDINGS

Public—Eight-story Government printing office building in Washington, D. C., was bid in by **McCloskey & Co.,** of Philadelphia, for $4,372,700. **Lundoff-Bicknell Co.,** of Chicago, obtained a $1,447,192 contract for administration building at Soldier Field, Chicago. Veterans hospital at Murfreesboro, Tenn., is being built by **N. P. Severin Co.,** of Chicago, for $1,382,530. In Provo, Utah, **Ulen Construction Co.,** of Lebanon, Ind., has started work on a $850,000 municipal power and light plant. State Capitol annex in Denver, Colo., went to **F. J. Kirchhof Construction Co.,** of Denver, for $774,450.

Commercial—Among recent housing developments are the following: At Rockville Center, N. Y., 189 2-story dwellings costing $2,000,000, by **G. W. Loft,** of New York City. In San Gabriel, Calif., 840 dwellings costing $1,000,000, by **Percy Bilton, Inc.,** of Pasadena, Calif. In Hapeville, Ga., 250 homes costing $1,000,000, by **J. Wayne Moore.** In Cleveland, Ohio, 100 2-story houses costing $1,000,000, by **I. G. Kohn,** of Cleveland. In Flushing, N. Y., 127 houses costing $760,000, by **Maslow & Kenin,** of Brooklyn, N. Y. In Miami, Fla., 60 homes and 15-apartment buildings costing $650,000, by **Scott-Perry Corp.,** of Miami.

A 10-story hospital in New York City is under construction for $1,500,000 by **Irons & Reynolds,** of New York. Alterations to the store of B. Altman & Co. are being made for $1,000,000 by **Marc Eidlitz & Son, Inc.,** of New York. **Butler Bros.,** of St. Paul, Minn., are building a 6-story hospital in Detroit, Mich., to cost $750,000. Bus terminal in Portland, Ore., costing $500,000 is under construction by L. H. Hoffman, of Portland. The $500,000 7-story hotel in Juneau, Alaska, went to A. W. Quist Co., of Seattle, Wash.

Industrial—Chemical plant addition for Ethyl-Dow Chemical Co., at Kure Beach, N. C., was awarded to **The Austin Co.,** of Cleveland, Ohio, for $2,500,000. Cigarette paper plant extension in Brevard, N. C., **went to Fiske-Carter Construction Co.,** of Greenville, S. C., for $2,000,000. Power plant extension in Shreveport, La., to cost $1,099,500 was obtained by **L. E. Meyers Co.,** of Chicago.

BRIDGES

For the new $1,500,000 International bridge over Niagara River at Niagara Falls, N. Y., substructure contract went to **Wright & Kremers, Inc.,** of Niagara Falls, and contract for removal of wreckage of old bridge to **Buffalo House-Wrecking & Salvage Co.,** of Buffalo, N. Y. At Pittsburgh, Pa., **H. Butch,** local contractor, received $755,-087 job on south approach to Highland Park bridge. Successful bidder on Potomac River bridge, between Maryland and West Virginia, was **G. F. Hazelwood,** of Cumberland, Md., with price of $685,578. Completion of New York approach to George Washington bridge, New York City, went to **Walter Kidde Constructors, Inc.,** of New York City, for $1,110,672.

MISCELLANEOUS

For constructing land section of Queens-Midtown tunnel, New York, contract for $3,286,020 was awarded to **Woodcrest Construction Co.,** and **Rosoff Bros.,** of New York.

SEWERS

Contract amounting to $2,928,064 went to **Arthur A. Johnson Corp.,** and **Necaro Co., Inc.,** of New York, for building intercepting sewer connecting with Wards Island sewage treatment works, New York City. For a sewage pumping station in Chicago, **M. J. Boyle Construction Co.,** of Chicago, was successful bidder with price of $888,488. In Brooklyn, N. Y., low bid of $771,134 for sanitary sewers was submitted by **Luang Construction Co.,** of Brooklyn. Intercepting sewer and pumping station at Plattsburg, N. Y., is being built by **L. Capoldi & Son,** of Providence, R. I., for $340,000.

Are You Moving to a New Job?

Unlike workers in "indoor" industries, construction men don't stay put for any great length of time. Theirs is an "outdoor" industry, requiring frequent moves from job to job, as one project is completed and another, hundreds or thousands of miles away, begins.

Before you shove off to a new locality tell our Circulation Manager to have **CONSTRUCTION Methods and Equipment** sent to your **new** address. Filling out the following form will do the trick:

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Personal

EVER SINCE this company assumed in 1927 the publication of this journal I have been a member of its staff. For more than nine years I have used this Publisher's Page to record a monthly comment dealing with some aspect of construction practice.

Whatever of interest or value the reader may have found or found lacking on this page, the writing of it has been one of the most pleasant and stimulating parts of my job. It has offered an opportunity to exchange ideas with thousands of people engaged in engineering and construction whom I probably never could have met in person. To any worker in any department of journalism such an opportunity is of priceless value.

For it goes without saying that the comment of this page has not been all one way. I have received fully as much as I have given. Some of the return cargo has consisted of commendation, some of it of debate and discussion and some of it has been critical. Yes, and at times, *quite* critical.

But, thumbs up or thumbs down, it all has been welcome. And I am grateful beyond expression to those who during these years have written or spoken to me concerning what I may have had to say on this page.

AND NOW that I must lay down the task, I take this means of telling every reader of this page my regret at the breaking of a contact that has come to mean so much to me.

For I have relinquished my post as publisher of *Construction Methods & Equipment* to become publisher of *Business Week*, the McGraw-Hill weekly magazine of business news and interpretation. In that capacity I must extend both my interests and my efforts in keeping with the scope of general business and industrial affairs; so I find myself unable to continue my contribution to this page.

In taking regretful leave of those who have been sufficiently interested to follow what has been written here and so generous of their time and thought as to comment upon it, I take this means to acknowledge my appreciation of their interest and support.

Needless to say, engineering construction remains and must always be a vital part of the American business and industrial scene. During my thirty-five years of association with it, its affairs naturally have become a part of my own being. I expect, therefore, to maintain always the same keen interest in its doings and in the welfare of those who may carry on its manifold activities.

Willard Chevalier

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3/4 YD. LORAIN-40
6-cylinder
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Thus Diesel "never-say-die" lugging power and surprising fuel economy are added to those power characteristics of the Lorain-40 which have enabled it to establish such outstanding yardage records... These have been largely due to its Center Drive design which gives a direct-to-the-point application of power—and which is the only design in which the full engine power can be concentrated on any one operation—and now this can be Caterpillar Diesel power!
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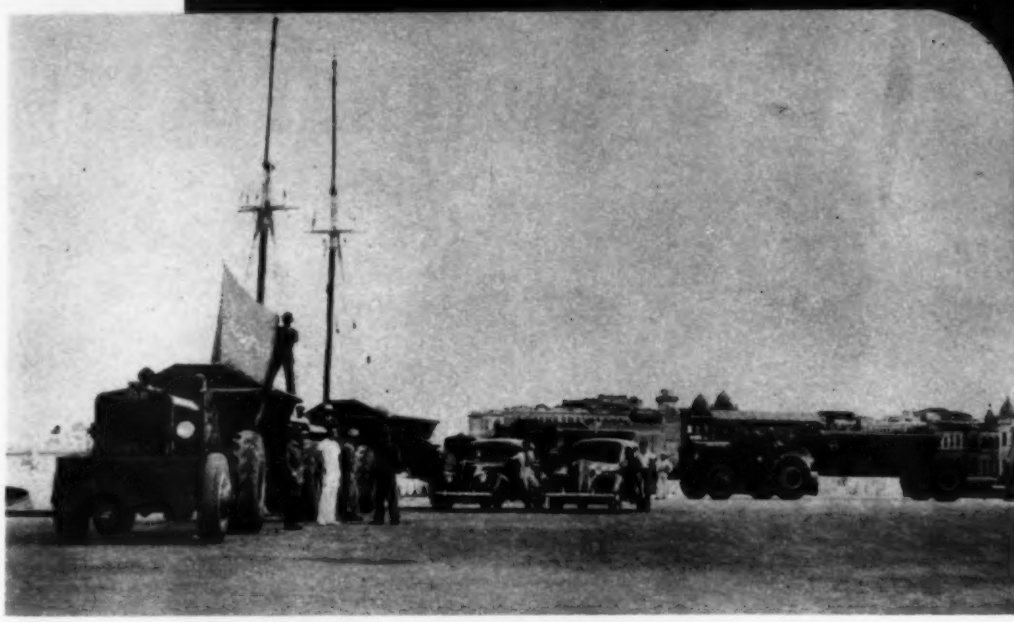
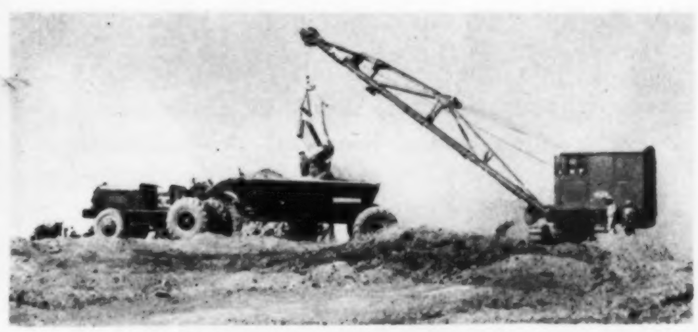


Quickly erected at end of water journey and poised for the dash inland.

The Inspectoria Federal De Obras Contra As Seccas (Federal Commission for Works against the Drouths) finds that Trac-Truk mobility and cycle time production solves a vexing problem in dam and highway construction in Northern Brazil. Eight model FDT 15 yard bottom dump Trac-Truks are now assisting in the construction of the great Curema Acude, a huge three million cubic yard earth fill dam located in Western Parahyba near the town of Curema 6 degrees south of the equator. The first fleet of 4 units, heavily loaded with Diesel oil and supplies and each unit weighing about 15 tons, made the pioneering run of 450 miles inland in 43 hours of driving time, striking proof of Trac-Truk mobility. Cycle Time Production of the first fleet of four units resulted in purchase of second fleet of four units. Trac-Truk performance under skillful Brazilian direction and management equals American performance. From the loading dragline to the embankment 2600 feet away and back to the dragline is a matter of 7.1 minutes with 1.0 minute spent in turnings and dumping. Average travel speed is at its usual high figure of 10 miles per hour over soft borrow pit, haul road, and soft fill. The Inspectoria has tried successively all modern methods of moving earth. Finally and conclusively Euclid Trac-Truks are finishing the job at lower hauling costs. In America it is "Less cents per cubic yard by Trac-Truks." In Brazil it is "Less milreis per cubic meter by Trac-Truks."

One of many bridges erected during 450 miles of rough inland travel.

Plenty of dust and dirt at 125 degrees.



Working near the equator.

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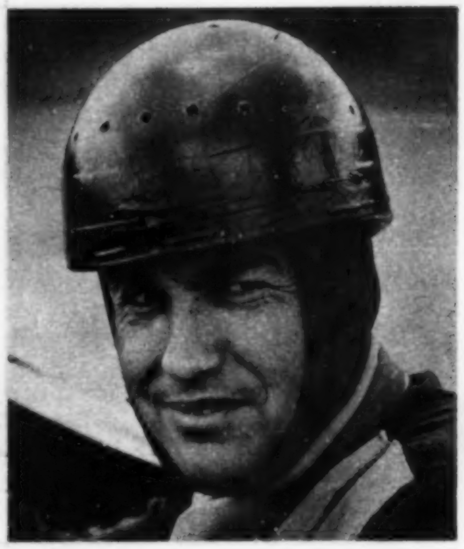
GULF WINS

1ST, 2ND, 3RD AT INDIANAPOLIS!

Winner Floyd Roberts averaged 117.2 M.P.H. in the 500-mile classic.

Wilbur Shaw averaged 115.5 M.P.H. to finish second.



Chet Miller averaged 114.9 M.P.H. to finish third.

Record-breaking drivers use GULFPRIDE OIL!

All three winners of the Indianapolis Memorial Day Race used—not special racing castor oils—but regular, stock Gulfpride . . . certified by the AAA Contest Board to be the identical oil sold by Good Gulf dealers everywhere!

Here's what the winners say about Gulfpride:

> "Perfect lubrication provided by Gulfpride Oil played an important part in helping us win first, second, and third places in the 500-mile Memorial Day Race here at Indianapolis. Unfaltering performance of our engines throughout the gruelling race enabled us to attain faster average speeds than ever before had been achieved at this speedway."
>
> *(Signed)* Roberts, Shaw, Miller

These three all-time record-smashing performances testify to Gulfpride's ability to stand up under punishment. That's why Roberts, Shaw, Miller and many other prominent racing drivers choose Gulfpride over even special racing oils. The reason is that Gulfpride is the world's only 100% Pure Pennsylvania oil refined by the Alchlor process, *in addition to* conventional methods.

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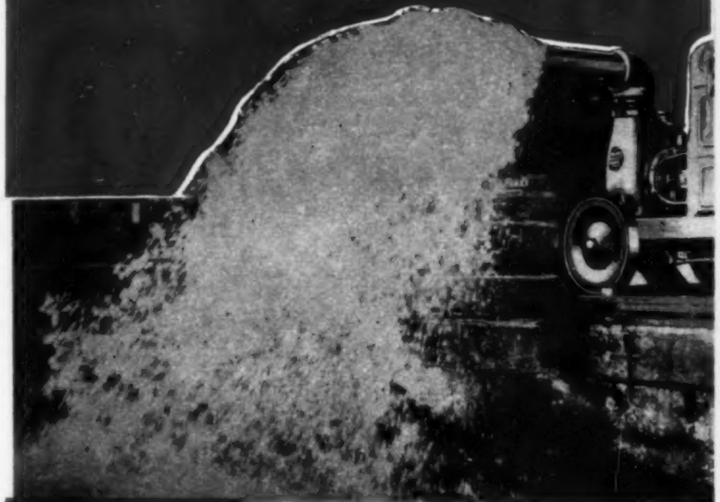
GULF INDUSTRIAL LUBRICATION

Water Meets Its Master When You Use a JAEGER PUMP



Jaeger "Handy"—Lowest Priced 7000 Gallon Pump

Compact 2", 3", 4", 6" Models—10,000 to 90,000 G. P. H.

Faster Priming + High Efficiency + Longer Service = LOWEST COST per GALLON

Contractors put more faith and money into Jaeger Sure Prime Pumps than any other make. They'll tell you it's because no other pump KNOWS HOW TO HANDLE WATER like a Jaeger.

You can prime and pump a tiny trickle of air and water or a roaring flood of 220,000 gallons an hour. You can suck dry the wettest sand, lift water from the deepest hole, jet it or force it out through miles of pipe. On any job where water is a problem, give it to a Jaeger Sure Prime. You'll have a pump that will prime faster, pump harder, work thousands of hours longer—for less money than you've ever paid for pumping.

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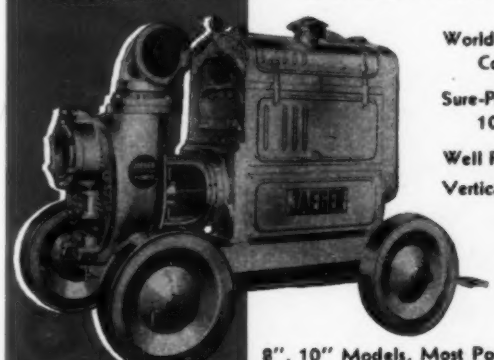

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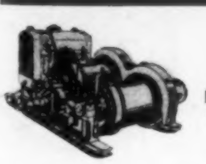
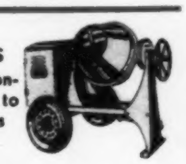


HOISTS from 10 to 100 H. P.



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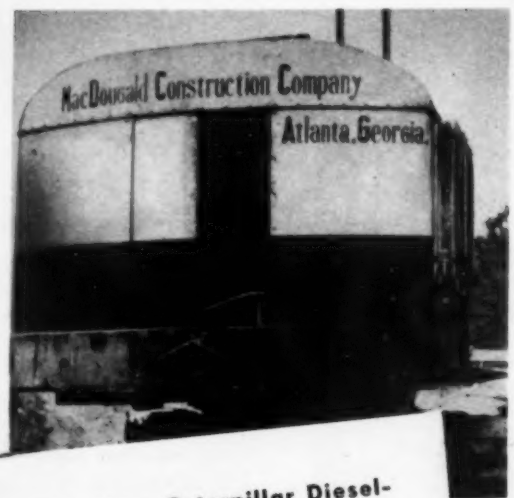

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This Lima Caterpillar Diesel-powered Shovel is handled by Sam Cook, outstanding shovel operator in the Atlanta Area. Mr. Cook and Texaco 100% make an unbeatable combination. Mr. MacDougald and Mr. Stephenson are in foreground.

WHEN The MacDougald Construction Co., of Atlanta, Georgia, gets on a job, it "goes to town"; leaves nothing to chance.

MacDougald gives special attention to lubrication . . . has proved it a big factor in preventing breakdowns and interrupted work-schedules, thus completing jobs *ahead* of schedule.

On this Newberry-to-Strother, S. C., highway job (Project 187), all Caterpillar shovels, tractors, trucks are Texaco lubricated 100%.

Trained lubrication engineers are always available to aid you with your selection and application of Texaco Lubricants. Prompt deliveries assured through 2108 warehouse plants throughout the United States. Call the nearest Texaco warehouse, or write to—

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makes eight for Merritt, Chapman and Scott
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Northwest ⅝ yd. crane jetting down piles for Merritt, Chapman and Scott.
CONTRACTORS all over the country are finding out that Northwest advantages mean output on the smaller Northwests as well as on Northwests of larger capacity. That is why contractors like Merritt, Chapman and Scott of New York City who have used Northwests for years are buying them. They have proved the value of the "feather-touch" control, the cushion clutch, uniform pressure swing clutches and the other Northwest features.
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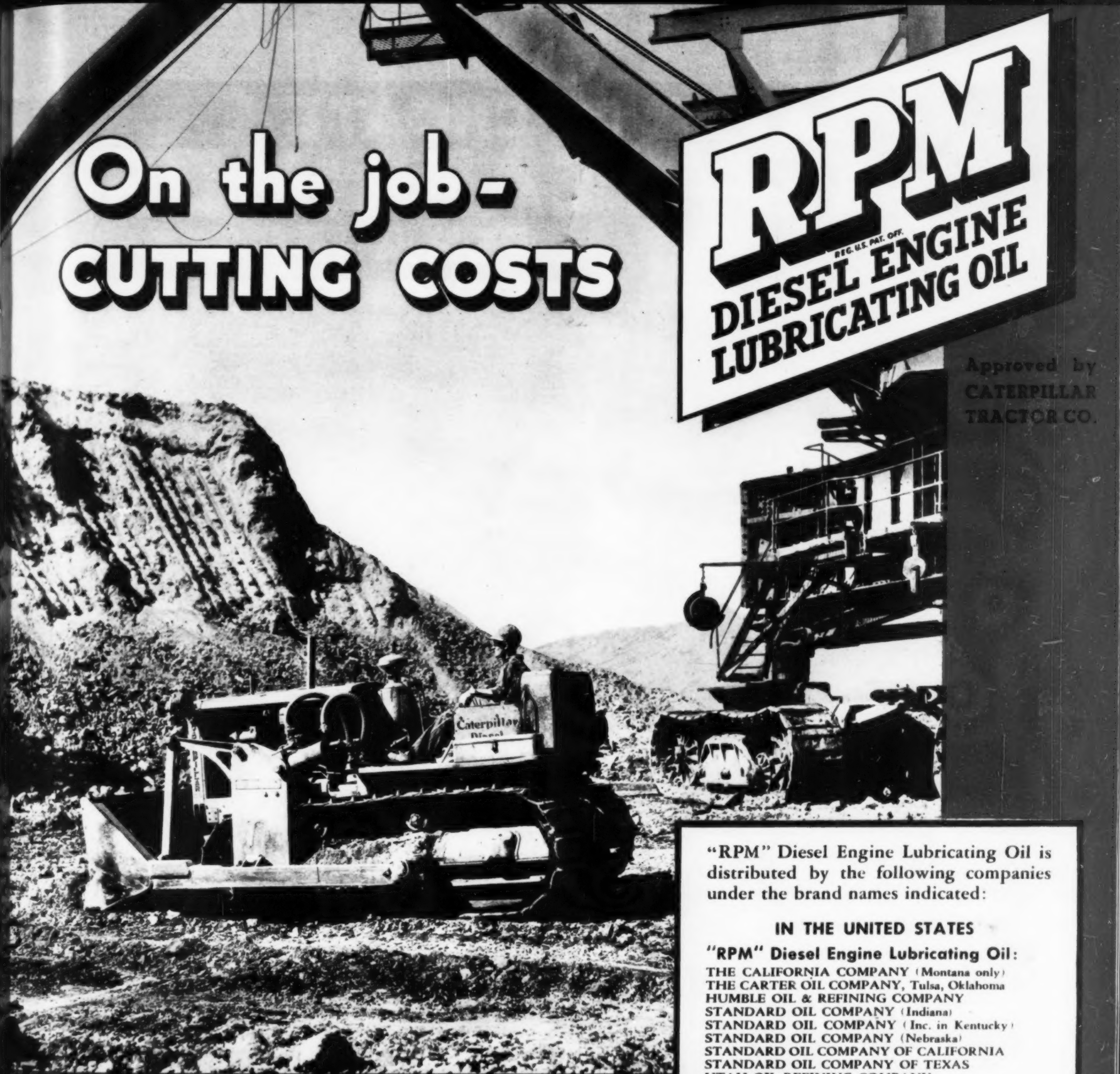

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L. H. Sherwood, Little John Coal Company, Indianapolis, Indiana writes: ". . . . the service we have been securing from 'RPM' Diesel Engine Lubricating Oil has been most excellent. We are operators of a Bucyrus-Erie Drag Line D-1300 'Caterpillar' Engine, and 'Caterpillar' RD6 and RD7 with BullDozers . . .

"They have all been put to extremely hard usage as they are called upon to work twenty-four hours-per day schedules with out short lay ups for fueling, lubrication, and ordinary maintenance. Satisfactory manner in which these machines have performed has materially aided the efficient operation of our coal properties."

LITTLE JOHN COAL COMPANY,
(Signed) L. H. Sherwood

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The Scrapers that load larger loads!

THE LaPlant-Choate "Carrimor" Scraper opens the way to greater profits because you can move more material in less time.

These rear dumping scrapers are scientifically designed to load larger loads with less power. They unload sticky material with ease and spread it in layers or dump it in one pile on the fill or over the bank.

In loading they cut a smooth level grade. Their accurate control permits them to do the entire job even to dressing the grade. Hard, frozen ground or sticky clay is no obstacle.

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LAPLANT-CHOATE MEANS *Lower Costs*

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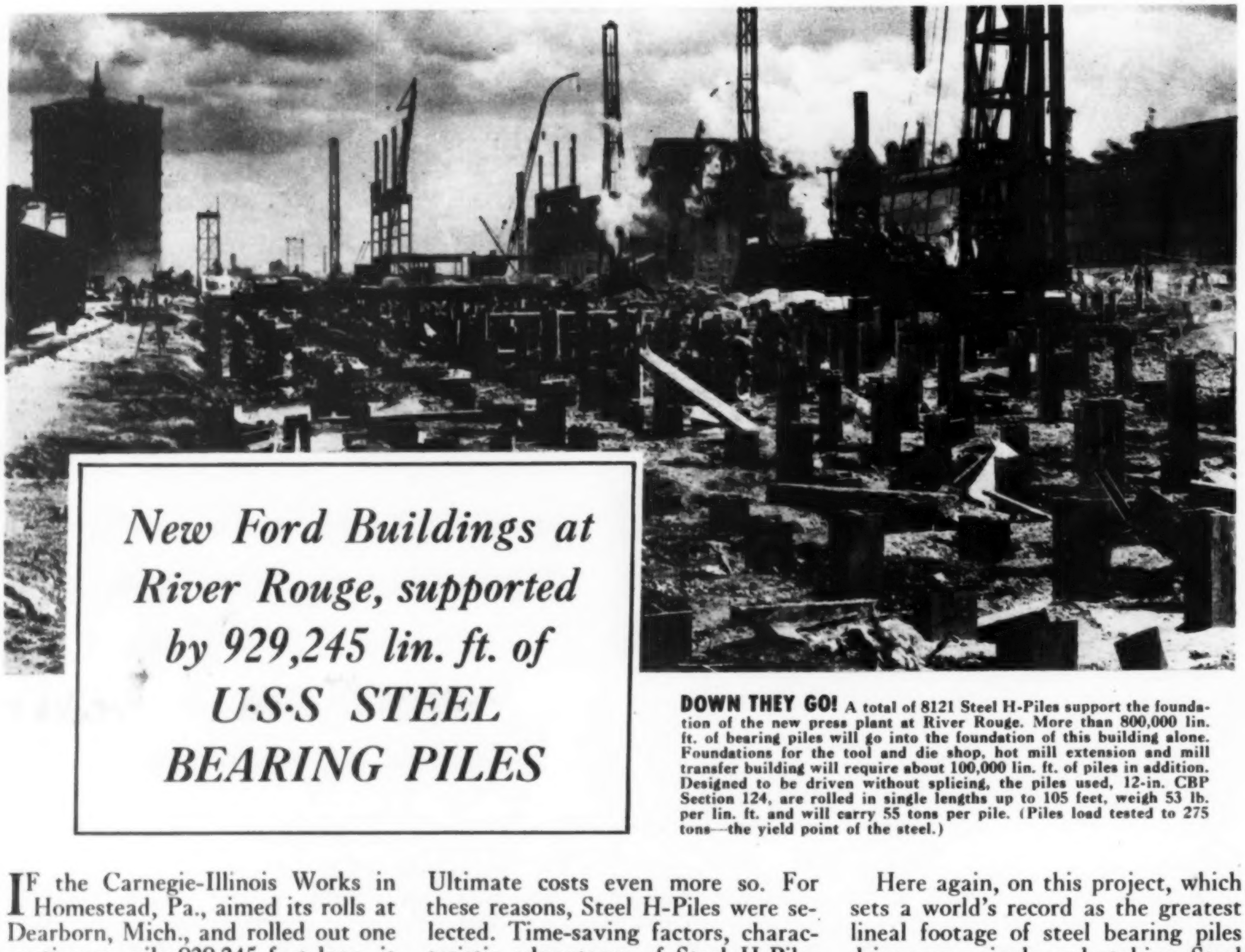


New Ford Buildings at River Rouge, supported by 929,245 lin. ft. of U·S·S STEEL BEARING PILES

DOWN THEY GO! A total of 8121 Steel H-Piles support the foundation of the new press plant at River Rouge. More than 800,000 lin. ft. of bearing piles will go into the foundation of this building alone. Foundations for the tool and die shop, hot mill extension and mill transfer building will require about 100,000 lin. ft. of piles in addition. Designed to be driven without splicing, the piles used, 12-in. CBP Section 124, are rolled in single lengths up to 105 feet, weigh 53 lb. per lin. ft. and will carry 55 tons per pile. (Piles load tested to 275 tons—the yield point of the steel.)

IF the Carnegie-Illinois Works in Homestead, Pa., aimed its rolls at Dearborn, Mich., and rolled out one continuous pile 929,245 feet long, it would extend 176 miles across Pennsylvania, Ohio and Lake Erie or almost nine-tenths of the distance to the Ford Motor Company's new plant extension. That's a rough idea of the enormous amount of Steel H-Piles driven to provide permanent foundation for the new buildings of the Ford Motor Company's $40,000,000 expansion program.

Time was important on this job. Ultimate costs even more so. For these reasons, Steel H-Piles were selected. Time-saving factors, characteristic advantages of Steel H-Piles speeded up installation and insured the rapid progress essential to economy. Their high load capacity reduced the number of piles required to carry the load—meant fewer piles to drive. Individual piles were handled more rapidly because the single long-lengths made splicing unnecessary—meant fewer pieces to handle. Easier driving and absence of "heaving" further increased speed and reduced costs.

Here again, on this project, which sets a world's record as the greatest lineal footage of steel bearing piles driven on a single undertaking, Steel H-Piles illustrate the two important and outstanding advantages they offer foundation designer and construction engineer; first, steel sections specially designed to offer the strongest, most permanent, most easily driven form of bearing pile you can use; and second, an unfailing dependable source of supply that makes them immediately available regardless of the size or location of the job.

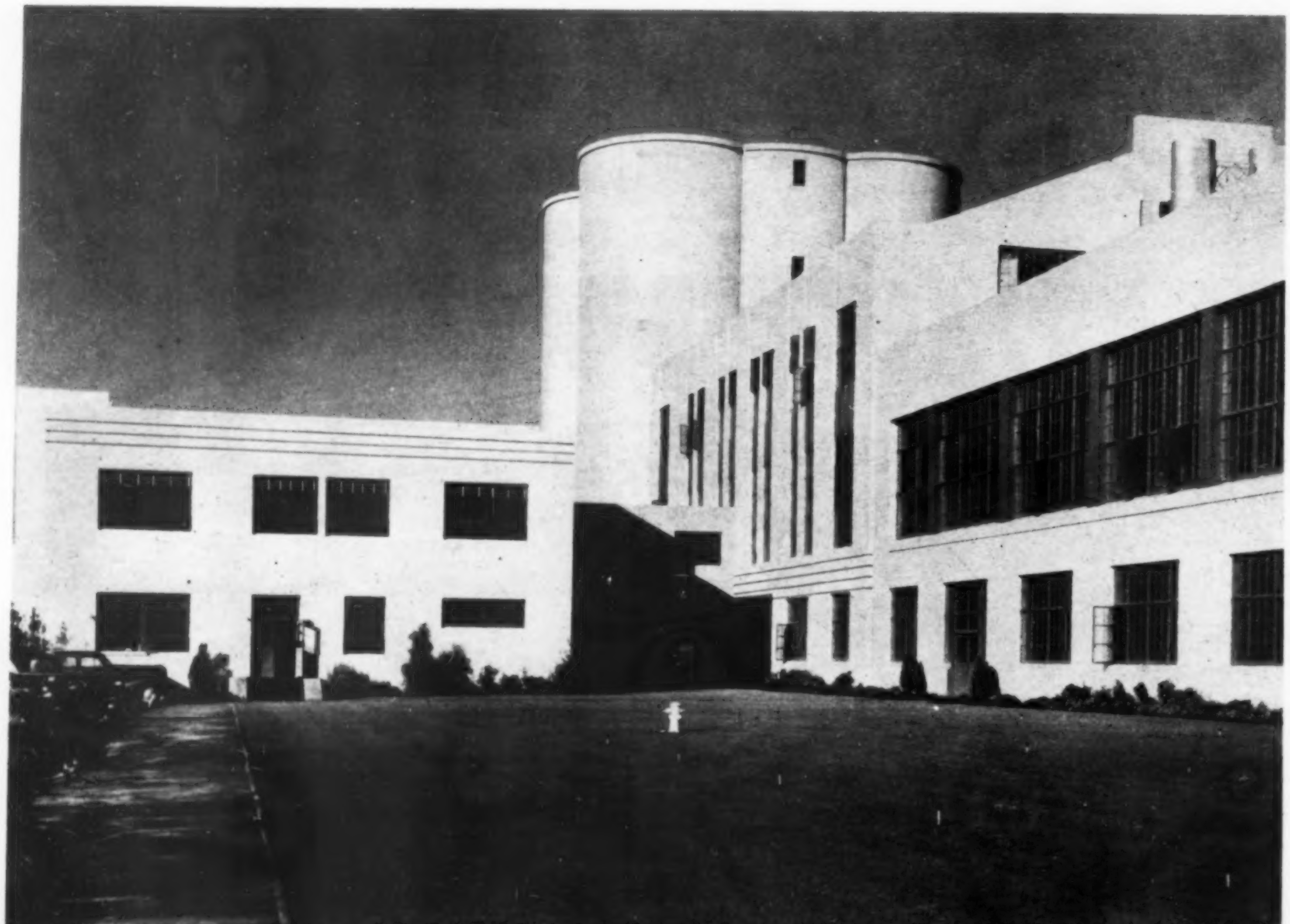
U·S·S STEEL BEARING PILES

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh USS *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL



It's no trick to Form Concrete for Architectural Beauty

There'll be lots of contract jobs like this in 1938

A reputation for being a top-notch builder of Architectural Concrete is a mighty valuable asset. It puts you in line for the big jobs on factories, offices, theaters and schools, as well as for the hundreds of one and two-story commercial buildings that are "going concrete" in 1938.

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PORTLAND CEMENT ASSOCIATION
Dept. A7-16, 33 W. Grand Ave., Chicago, Ill.
A National Organization to Improve and Extend the Uses of Concrete

• Spreckels Sugar Company Plant No. 3, near Woodland, California. Includes administration building and laboratory, warehouse in rear, and 5 bulk storage bins — all of reinforced concrete with concrete floors and exterior walls. Architect, Harry A. Thomsen, Jr., successor to George W. Kelham; contractor, Dinwiddie Construction Co. — both of San Francisco.

Architectural Concrete — WALLS AND ORNAMENT CAST INTEGRAL WITH FRAME AND FLOORS

Can you Compete without a Loader?

THE primary advantage of the Bucket Loader is simple—it is the cheapest means of loading bulk material. It will probably pay for itself even though you have other equipment now being used for loading. It is generally regarded as one of the most valuable tools for contracting. In addition to low cost, high capacity loading, it is advantageously used for screening, stripping, light excavating, accurate grading, backfilling, etc.

The B-G 82-A Bucket Loader is an outstanding achievement in equipment design. Synchronized Feeding gives higher capacity with less power consumption; the Automatic Overload Release protects the machine, eliminates delays; Slow Crowding Speed gives easier, more efficient operation; Fast Traveling Speed saves money and time; Tank Type Chassis Frame gives greater strength; and encloses all driving mechanism; Floating Boom allows crowding thrust to go direct from crawlers to feeding end; the Full Crawler Mounting gives maneuverability that saves time on every move; and the B-G Snow Loader boom can be mounted on the same chassis.

•

It will pay you to investigate the Barber-Greene Bucket Loader.

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Also ask for our new 52 page booklet "Good Roads" which shows the complete line of Barber-Greenes for contracting.

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SELDOM LAID-UP *for* REPAIRS

...because they're constructed of

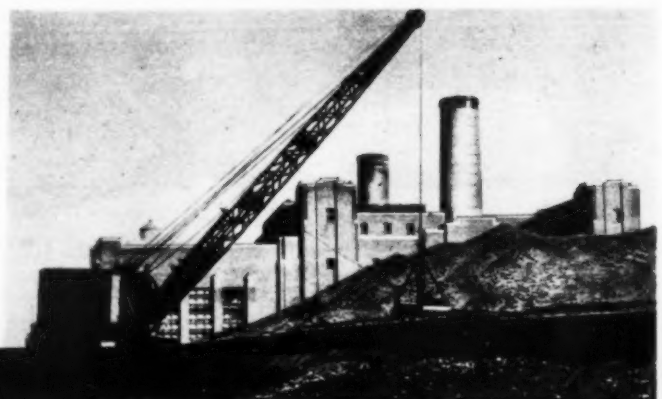
Courtesy of Marion Steam Shovel Co., Marion, Ohio.

No class of machinery tackles tougher assignments than excavating and material handling equipment such as conveyors, power shovels, cranes and drag lines.

Whether they are used for road building, foundation excavating, dam construction, surface mining or the scores of other construction jobs, they encounter high static and dynamic stresses, also heavy wear and abrasion.

Once the master mechanic and his crews worked many an hour of overtime to keep these machines in repair. But not so to-day.

Through the use of tough, strong, hard,



Courtesy of Link-Belt Co., Chicago, Ill.

wear-resisting Nickel Alloy Steels, leading manufacturers are turning out machines that perform dependably day in and day out with few interruptions due to breakage or excessive wear of vital parts.

Listed at the left are some of the applications where forged and cast Nickel Alloy Steels are generally used to-day to make this type of equipment more reliable.

Consultation is invited on the use of enduring Nickel Alloy Steels in your equipment.

Courtesy of the Wellman Engineering Co., Cleveland, Ohio.

APPLICATIONS

of the Nickel Alloy Steels in excavating and material handling equipment

- Racks, booms, sheaves
- Upper and lower frames
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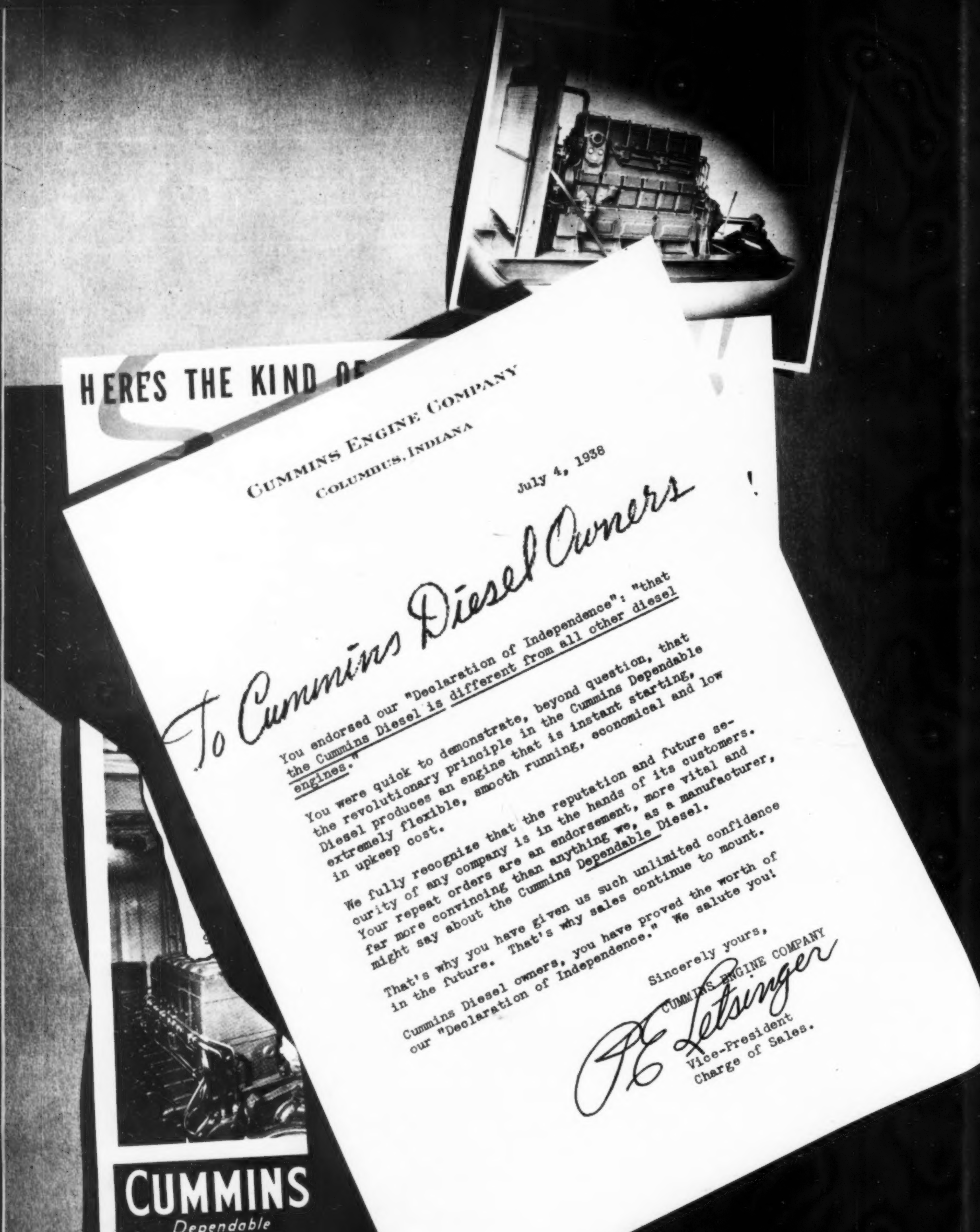
- Pinions and sprockets
- Crawler parts
- Hoist and drive gears
- Hoist drum shafts
- Shipper shafts
- Track pins
- Dipper buckets
- Bucket teeth and lips

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.


HERE'S THE KIND OF
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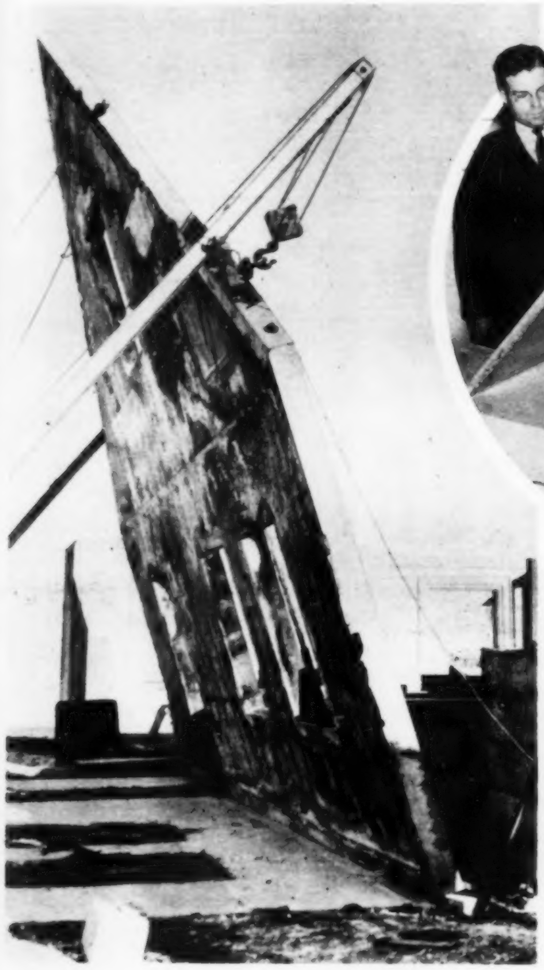
CUMMINS ENGINE COMPANY
COLUMBUS, INDIANA
July 4, 1938
To Cummins Diesel Owners
You endorsed our "Declaration of Independence": "that the Cummins Diesel is different from all other diesel engines."
You were quick to demonstrate, beyond question, that the revolutionary principle in the Cummins Dependable Diesel produces an engine that is instant starting, extremely flexible, smooth running, economical and low in upkeep cost.
We fully recognize that the reputation and future security of any company is in the hands of its customers. Your repeat orders are an endorsement, more vital and far more convincing than anything we, as a manufacturer, might say about the Cummins Dependable Diesel.
That's why you have given us such unlimited confidence in the future. That's why sales continue to mount.
Cummins Diesel owners, you have proved the worth of our "Declaration of Independence." We salute you!
Sincerely yours,
CUMMINS ENGINE COMPANY
R E Letsinger
Vice-President
Charge of Sales.
CUMMINS
Dependable
DIESEL

Construction Methods and Equipment

Established 1919 McGraw-Hill Publishing Company, Inc.

ROBERT K. TOMLIN, Editor

Volume 20 **July, 1938** Number 7



"TILT-UP" METHOD

Erects Precast House Walls

TILTING MAST HOIST, without guys **(left),** upends precast concrete wall unit from horizontal position where concrete was poured. MODEL of mast hoist **(inset)** is used to demonstrate operation.

FOR CONSTRUCTING the walls of concrete houses the "tilt-up" method is being perfected and shows promise of economies, according to A. L. Rehnquist, housing consultant, Portland Cement Association. In this method walls for the entire side of a house up to 40 ft. in length are constructed as a unit horizontally on the floor of the house and raised into position by a special guyless tilting mast hoist. The walls are tied together at the corners with cast-in-place concrete columns having vertical steel extending up from the wall below. Protruding horizontal wall bars also are embedded in the column.

Walls cast horizontally, it is recommended, should not be raised until from 2 to 4 days old, depending on curing conditions, size of wall and other factors. Sometimes it is possible to raise walls made of high-early-strength concrete in 24 hr. A crew of 4 men and foreman is sufficient to tilt the walls into vertical position, as no piece of the necessary equipment weighs more than 300 lb. The hoist is capable of lifting a total load of 7,500 lb. on each mast. Raising of wall and dismantling of hoisting equipment takes about 2 hr.

This method of constructing house walls is best suited to 1 and $1\frac{1}{2}$-story houses where each wall is cast in one piece. However 2-story houses can and have been built by casting each story wall on its respective floor. By using the tilt-up method contractors have claimed a saving of from 20 to 35 per cent in the cost of labor over walls built in place vertically.

CASTING OF WALL is done in horizontal position on ground floor of structure. Worker uses screed to finish course of concrete over reinforcement.

This Month's "News Reel"

CONCHAS DAM, U. S. Engineer Department flood control structure on the South Canadian River in New Mexico, is shown in this view as about 40 per cent completed, with approximately 265,000 cu.yd. of concrete placed by the contractors, Bent Bros., Inc., and Griffith Co., of Los Angeles, Calif., under $4,587,676 contract. Most of foundation for high portion of dam has been covered. Main dam is concrete gravity structure 235 ft. high, containing 670,000 cu.yd. of concrete, flanked by wing dams and earth dikes. Construction is under direction of Capt. Hans Kramer, Corps of Engineers, U. S. Army, district engineer.

SCHOOL OF ARCHITECTURE BUILDING (right) for Massachusetts Institute of Technology at Cambridge, Mass., has 320-ft. long facade and will cost $1,400,000. Foundation required driving of 2,038 oak piles. Design provides reinforced concrete frame for north and south wings and structural steel frame for central or dome and portico section. Contractors are Stone & Webster Engineering Corp., of Boston.

TVA TESTIMONY is given before Joint Congressional Committee in Washington, D. C. by DR. ARTHUR E. MORGAN, former chairman of the Authority who was removed by the President for "contumacy" in failing to answer White House quiz.

GAIN IN MEMBERSHIP (right) last year, amounting to 275 per cent, wins Cashman trophy for Houston, Tex., Chapter of Associated General Contractors of America. EDMOND A. FRETZ, chapter president and head of the Fretz Construction Co., receives silver cup on behalf of his Houston associates.

DESERT RIPPLES (right) of white sand lap edges of U. S. Bureau of Reclamation's All-American Canal, forming new artificial river now nearing completion across California near Mexican border. Covering length of 80 mi. and involving more than 60,000,000 cu. yd. of excavation, canal extends from Imperial diversion dam on Colorado River near Yuma, Ariz., to western boundary of Imperial Valley. LEO J. FOSTER is construction engineer in charge of the project for the Bureau of Reclamation.

STRUCTURAL STEEL is again being erected at Rockefeller Center, New York City, — this time for the Associated Press building which is under construction by the Bethlehem Steel Co., for Hegeman-Harris Co., of New York, general contractor. In shadow of existing skyscraper unit of world famous building group in midtown Manhattan, guy derrick hoists to place heavy girders ranging in weight up to 28 tons to support columns over news reel theatre at ground floor level of structure.

TRAFFIC PRETZEL of complicated design carries cross-currents of vehicular flow near Flushing Bay, New York City, at north side of site for New York World's Fair, 1939.

BIDS ARE OPENED June 1 for Shasta dam, outstanding feature of U. S. Bureau of Reclamation's Central Valley project in California. WALKER R. YOUNG, construction engineer for Bureau, reads prices of low bidder, Pacific Constructors, Inc., of Los Angeles, totaling $35,939,450. Dam 560 ft. high and containing 5,610,000 cu.yd. of concrete will be world's second largest concrete structure, both as to height and mass. Stockholders of Pacific Constructors, Inc., include Griffith Co.; Metropolitan Construction Co.; Lawler & Maguire; Arundel Corp.; American Concrete & Steel Pipe Co.; Foley Bros.; D. W. Thurston; Shofner, Gordon & Hinman; W. E. Callahan Co. and Gunther-Shirley Co.; A. Guthrie & Co.; L. E. Dixon Co.; and Hunkin-Conkey Co.

Bid opening board includes **(left to right):** Robert S. Thomas, assistant engineer; Mr. Young; Nelson B. Hunt, office engineer; Arthur R. Honnold, district counsel; and Harry S. Riddel, assistant engineer.

YEAR'S PROGRESS is pictured in this night view of Marshall Ford dam, U. S. Bureau of Reclamation project on Colorado River of Texas. Concreting on 190 ft. high, 2,285 ft. long flood-control and water conservation structure was begun in November, 1937, by Brown & Root, Inc., and McKenzie Construction Co., under a $5,781,235 contract, and was 45 per cent complete last month. For the Bureau of Reclamation, E. A. Moritz is in charge as construction engineer.

HOURLY EXPENSE OF OWNING AND OPERATING HAULING EQUIPMENT

● THIS ARTICLE is the second of a group based on 75 field studies of pneumatic-tired automotive haulage on construction jobs. Each article is a complete unit containing information immediately applicable by contractors, estimators and hauling superintendents. Taken as a whole, the entire group of articles will provide comprehensive analyses of pneumatic-tired hauling costs. The first article, in last month's issue, described a typical field study lasting two days. Many of the field studies from which data were obtained covered much longer periods.

By HORACE K. CHURCH

Engineer, Euclid Road Machinery Co., Cleveland, Ohio

EXAMINATION of the elements of cost of ownership and operation of pneumatic-tired hauling equipment, together with their dollars and cents values and percentages, brings some pertinent facts to attention and leads to sound thinking regarding the unit cost of hauling. As a basis for discussion there is reproduced with these notes an hourly cost table for a bottom-dump semi-trailer type earth-hauling unit which may be equipped with optional gasoline engine or diesel engine of equivalent horsepower.

Fixed Charges — In general, fixed charges are a function of delivered price. In the example cited, they average 40 per cent of the total cost of ownership and operation. Accordingly, a difference of 10 per cent in delivered prices of two units of approximately the same weight and capacity changes total hourly expenses by about 4 per cent, all other elements being equal. However, production may readily be increased or decreased by 10 per cent because of a 10 per cent difference in delivered price, and unit cost will be changed accordingly. For example:

Two trucks of similar capacity cost \$11,000 and \$12,000, a difference of 9 per cent in initial cost. The more costly truck has a larger engine, generally more rugged construction, and better gear ratios for the job under consideration — the removal of limestone overburden. It has been demonstrated that the \$12,000 unit will consistently haul 25 solid yards of overburden each working hour as against 22 solid yards for the \$11,000 unit. Thus a 9 per cent increase in initial cost results in a 14 per cent increase in production. If all elements of hourly cost remain the same with the exception of fixed charges, the percentage difference in unit costs is expressed by:

$$\text{Unit cost by \$11,000 unit} = \frac{40\% + 60\%}{100\%}$$

$$\text{Unit cost by \$12,000 unit} = \frac{40\% \times 109\% = 60\%}{114\%}$$

$$\text{Difference in unit cost} = \frac{40\% + 60\%}{100\%} - \frac{(40\% \times 109\%) + 60\%}{114\%}$$

equals 10 per cent in favor of \$12,000 unit

A rule of thumb to be used when comparing two trucks of similar capacity and nearly similar prices is that the more expensive unit is justified if it will show a production percentage increase greater than one-half of its percentage increase in price.

Repairs and Replacements — It is a common error to underestimate costs for mechanical repairs and replacements and for the labor required in making them. The two chief reasons for this underestimating are the optimism of the seller of machinery and the imperfect and incomplete records of the buyer or user. Usually the first 2,000 hr. of the life of the unit justify the optimistic predictions of the seller. Too often, however, the last 8,000 hr. give an overall cost in excess of the estimate.

It is most difficult to gather reliable figures on these costs, but it seems that 10 per cent of the delivered price per year of 2,000 hr. will cover the costs. Expressed otherwise, this allowance provides one-half of the delivered price of the unit for mechanical repairs and replacements (including labor) during a lifetime period of 10,000 hr. It is to be emphasized that this allowance is exclusive of the costs for tire and tube repairs and replacements, and it is likewise to be noted that the allowance holds properly for quality hauling equipment in the \$8,000 to \$16,000 heavy-duty classes.

Of the 10 per cent, perhaps two-thirds represents delivered price for materials and one-third represents labor costs. It is regrettable that the majority of users of heavy-duty hauling equipment do not possess itemized and allocated costs for parts and labor. In the writer's experience, only two users, one an Eastern industrial user and the other a Central States general contractor, have been able to furnish complete cost records covering both materials and labor for an individual piece of equipment.

In the analysis of hourly expense accompanying these notes, the estimated costs for mechanical repairs and replacements (including labor) average 15 per cent of the total charges. The fact that mechanical repairs and replacements (including labor) cost about 15 per cent of the total hourly expense when the unit is worked under average conditions throws some light on the foolhardiness of "railroading" or "razzing" equipment, particularly on contract jobs. The hauling cycle of a unit consists ordinarily of seven parts: loading, hauling, dumping, turning, returning, turning, and delay. If an attempt is made to "railroad" a hauling unit, only three phases of the cycle can be increased perceptibly — turning at the dump or fill, returning, and turning at the loading unit. These three phases make up about 32 per cent of the average industrial and construction hauling cycle. If on a job running smoothly and sensibly, an attempt is made to speed up these three operations by 50 per cent, the effort may very well double the cost of repairs. If speed is increased by 50 per cent, production is increased about 12 per cent and the total cost of ownership and operation has increased 15 per cent. Clearly then, unit cost has increased about 3 per cent under the "razzing."

Tires and Tubes — Users of automobile passenger cars usually think of life of tire in terms of miles, and an average figure for the United States might be about 20,000 mi. No such generalization can be made regarding heavy-duty tires for haulage. A few highlights from the writer's own experience will indicate the variables.

(1) In building levees under conditions shown in an accompanying photograph, where hauling units travel over loams, sands, and gumbos, bottom-dump semi-trailer hauling units equipped with 18.00x24 tires

GOOD HAULING CONDITIONS in loams, sands and gumbos on levee building operations enable bottom-dump semi-trailer units **(right)** to get 7,500 hr. of service from 18.00x24 tires with retreadings.

Hourly Expense for Ownership and Operation

Bottom-dump semi-trailer-type earth-hauling unit equipped with optional gasoline engine or diesel engine of equivalent horsepower (in 100-hp. range). Depreciation period — 10,000 hr., or 5 years of 2,000 hr. each.

	Gasoline engine		Diesel engine	
Approximate delivered price	$9,450		$11,300	
FIXED HOURLY CHARGES	Dollars	Per Cent	Dollars	Per Cent
Interest, taxes and insurance at 7 per cent of delivered price per year of 2,000 hr.	$0.33	9	$0.40	11
Depreciation by straight line method, with no salvage value	.95	27	1.13	32
	$1.28	36	$1.53	43
HOURLY OPERATING EXPENSES				
Mechanical repairs and replacements (including labor) at 10 per cent of delivered price per year of 2,000 hr.	$0.47	14	$0.56	16
Tires and tubes, repairs and replacements, at about $3,050 for 10,000-hr. life of unit	.30	9	.30	9
Gasoline, 3½ gal. at 16c. per gallon	.56	16		
Diesel fuel oil, 2½ gal. at 8c. per gallon			.20	6
Crankcase oil, 0.1 gal. at 50c. per gallon	.05	1	.05	1
Grease and greasing labor	.10	3	.10	3
Driver	.75	21	.75	22
	$2.23	64	$1.96	57
Total hourly expense for ownership and operation	$3.51	100	$3.49	100

have been in service more than 5,000 hr. and have traveled approximately 25,000 mi. The original tire equipment is on these units and apparently is good for considerably more mileage before retreading. A complete set of tires with retreading costs about $2,300. If the useful life of one complete set with retreading is assumed to be 7,500 hr., a reasonable estimate for this kind of service, then the hourly cost for tires and tubes is about 30c.

(2) Contrast the cost of 30c. per hour under good working conditions with the probable cost to be expected under conditions illustrated by two other photographs showing grading and hauling at the site for the New York World's Fair, on Long Island, where an old city dump was leveled. Unusual materials and haulage road conditions combined to impose a tire and tube cost of about $1 per hour per bottom-dump semi-trailer unit. In the second photograph, of planked runways atop the marsh mud, appears a rear-dump unit operating on the same project. For obvious reasons, tire and tube costs were excessive on the rear-dump units as well as on the bottom-dump units, the rear-dump units costing about 75c. per hour.

(3) In overburden haulage of earth and rock in Pennsylvania anthracite coal strip mines, 10-yd. rear-dump trucks, equipped with single 11.25x24 front tires and dual 13.50x24 rear tires, average about 2,500 hr. for each set of tires. As a set of tires costs about $1,500, the hourly cost for tires and tubes is about 60c.

Under average hauling conditions the life of a large 18.00x24 tire with retreading is about 7,500 hr., assuming that the tire is not overloaded and is being used in clays, sands, gravels and loams, with no tire hazards. Summary studies of fifteen bottom-dump semi-trailer-type hauling-unit operations show that the overall travel speed averages 5.5 mi. per working hour. The total life of the tire and retreading therefore is about 40,000 mi.

Life of smaller tires is shorter. Under average hauling conditions the life of an 11.25x24, 12.00x24, and 13.50x24 tire is about 2,500 hr., assuming that the tires are not overloaded and are used in earth and rock with natural tire hazards. Summary studies of eighteen rear-dump two-axle-type hauling-unit operations show that the overall travel speed averages 3.7 mi. per working hour. Total life of the tire is therefore about 10,000 mi.

As the cost of tires and tubes amounts to 10 to 25 per cent of the total cost of ownership and operation, it well pays the user to heed the following advice of a major tire builder:

(1) Overloading causes faster wear both by increasing unit pressure and by generating excessive tire heat which finally results in higher rate of tread wear and in heat blowouts. Examples: Overloads of 25 and 50 per cent decrease tire mileage by 35 and 60 per cent, respectively. Underloads of 15 and 30 per cent, on the contrary, increase tire mileage by 45 and 100 per cent, respectively.

(2) Underinflation results in fast, irregular tread wear caused by increased squirming and scuffing over the contact area. Underinflation also causes excessive flexing which in-

TIRE HAZARDS encountered in leveling old city dump for New York World's Fair site increase cost of tires and tubes to about $1 per hour for each bottom-dump semi-trailer unit.

PLANK RUNWAYS on top of marsh mud are one feature of World's Fair grading operation which helps to cause heavy tire and tube costs of 75c. per hour for rear-dump truck.

Gasoline vs. Diesel in 125-150-Hp. Unit

Difference in first cost, favoring gasoline unit	$1,000.00
Estimated working hours in one year	2,000

ESTIMATED DIFFERENCE IN HOURLY COST

Fixed Charges	
Interest, taxes, insurance — $\frac{7\% \times \$1{,}000}{2{,}000}$	0.04
Depreciation — $\frac{\$1{,}000}{10{,}000}$	.10
Mechanical repairs and replacements (including labor) — $\frac{10\% \times \$1{,}000}{2{,}000}$	.05
Favoring gasoline engine	$0.19
Fuel	
Gasoline, 5.5 gal. at 16c. per gallon	$0.88
Diesel fuel oil, 3 gal. at 8c. per gallon	.24
Favoring diesel engine	$0.64
Net saving in favor of diesel engine per hour	$0.45

TIME REQUIRED TO ABSORB ADDED COST THROUGH FUEL SAVINGS

Time in hours =	N
Difference in investment to be depreciated =	$1,000
Difference in interest, taxes and interest for period N =	$\frac{N (7\% \times \$1{,}000)}{2{,}000}$
Difference in mechanical repairs and replacements (including labor) for period N =	$\frac{N (10\% \times \$1{,}000)}{2{,}000}$
Difference in hourly cost of fuel =	$0.64

$$\text{Then } N = \frac{\$1{,}000 + \frac{N(7\% \times \$1{,}000)}{2{,}000} + \frac{N(10\% \times \$1{,}000)}{2{,}000}}{\$0.64}$$

= 1,800 working hours, or about 1 year

creases tire temperature, resulting finally in a higher rate of tread wear and in heat blowouts. Examples: Underinflations of 25 and 50 per cent decrease tire mileage by 25 and 75 per cent, respectively.

(3) Systematic rotation of tires, particularly in the case of tractor-trailer units, can increase overall tire mileage as much as 50 per cent.

To take advantage of these admonitions, it is important that the user of automotive hauling equipment know definitely the weight distribution of the loaded hauling unit in order to fit it with the correct tires.

Gasoline vs. Diesel Fuel — Fuel costs, averaging 11 per cent of the total cost of ownership and operation but differing by 10 per cent of the total, suggest the question of which engine to select for a hauling unit. A glance at the total costs for ownership and operation of the two units shows that they are in close agreement in spite of fuel saving of 36c. an hour in favor of the diesel engine. A study of the elements of the total costs discloses the reasons for the close agreement.

First, because of a difference in delivered price of $1,850 which is the extra price paid for the diesel engine, there is an additional hourly fixed charge of 25c. for the diesel unit, this amount covering interest, taxes, insurance, and depreciation. Second, on the premise that the cost for mechanical repairs and replacements (including labor) is proportional to the delivered price, there is an additional hourly charge of 9c. for the diesel unit. The sum of these two increments is 34c. which is within 2c. of the estimated fuel saving of 36c. hourly through the use of a diesel engine. This reasoning assumes that crankcase oil consumptions for the two equivalent horsepower engines are about the same and that the engines are equally dependable.

A differential of $1,850 between gasoline and diesel engines is rather high, although the writer has taken an actual example of two engines in the 100-hp. range. Another example changes the picture. In the 125-150-hp. range, a gasoline engine consuming 5½ gal. of fuel hourly and a diesel engine consuming 3 gal. of fuel are of approximately equal displacement and horsepower and the difference in cost is $1,000. The estimated difference in hourly costs for ownership and operation of the two engines is shown in an accompanying table, which indicates a net saving in favor of the diesel engine of 45c. per hour.

A prospective buyer, weighing the problem of gasoline engine versus diesel engine, usually wants to know how long a time must elapse before the fuel savings will absorb the total additional diesel charges. A second tabulation indicates the method of solving for the time in hours required to absorb the difference in cost.

Choice of a gasoline or diesel engine, then, depends on:

(1) fixed charges, including depreciation, interest, taxes, and insurance; (2) mechanical repairs and replacements (including labor); and (3) fuel saving, with careful consideration of present and pending taxes. The first two items ordinarily favor the gasoline engine, and the third item generally favors diesels.

Oil and Grease — Crankcase oil, hoist oil, grease and greasing labor, though apparently of minor importance, may constitute as high as 10 per cent of the total cost of ownership and operation. Obviously, they command close attention. It is well nigh impossible to get precise consumption and cost figures for these items, and, even if available, they would be of a very general nature. Crankcase oil consumption depends principally upon the condition of the engine. For engines from 500- to 750-cu.in. displacement, the consumptions, including oil changes, may vary from 0.1 to 0.3 gal. per hour.

Most hoist oil consumption values are equally elusive. The scrupulous master mechanic for a large industrial operation will call for an overhaul of hoisting mechanism as soon as hoist oil consumption reaches 1 qt. per shift, whereas the earth-moving superintendent on a dam project will not permit the truck to be removed from the swing if the consumption is even so high as 2 gal. per shift. Perhaps a fair estimate of limits of hoist oil consumption is from 0.05 to 0.10 gal. per working hour.

An average heavy-duty unit requires about one-third of a pound of grease per working hour, and two men can grease a unit in 20 min. at the end of a shift. Accordingly, a fair estimate for hourly cost of grease and greasing labor is about 10c.

In estimating it is not uncommon to minimize and perhaps totally eliminate the hourly charges for interest, taxes, insurance, crankcase and hoist oil, grease, and greasing labor. These items may very well total 20 per cent of the entire cost. Obviously the estimate of unit cost will be in error the same amount.

Driver — Cost of a driver is about 22 per cent of the total hourly expense. Every user of mechanical equipment is familiar with the advantages of having careful and skillful operators; but many users are apt to evaluate this difference in drivers at a thin dime or perhaps less. On the other hand, users probably will confess that the difference between a good operator and a poor operator may mean 10 per cent difference in production. Quick calculation reveals that a poor driver at 65c. per hour, hauling 50 yd. per hour, ultimately costs about ½c. more per pay yard than a good driver at 75c. per hour, hauling 55 yd. hourly.

IN AN ARTICLE to be published in an early issue Horace K. Church will analyze the hauling cycle and discuss the characteristics of the hauling unit which affect the various parts of the cycle.

Special Tackle Upends 130-Ton Tower

LIFTING LUGS at top of tower engage wire rope slings from heavy structural steel equalizing girder handled by 150-ton guy derrick

WITH THE AID of a guy derrick and special tackle, a new 130-ton bubble-type fractionating tower for petroleum distillation was hoisted into vertical position at the East Chicago, Ind., plant of the Sinclair Refining Co. The huge tower, with an outside diameter of 13 ft. 7 in., is 83 ft. 3½ in. long, of riveted and welded construction.

Arriving at East Chicago on two 52-ft. flat cars from the plant of the Heggie Co., in Joliet, Ill., the heavy tower was unloaded in horizontal position on to cribbing near the erection site. Two roundabout slings of 2-in. wire rope were used, each sling being fastened to the end of a heavy steel equalizing girder to which the load block of a derrick was attached.

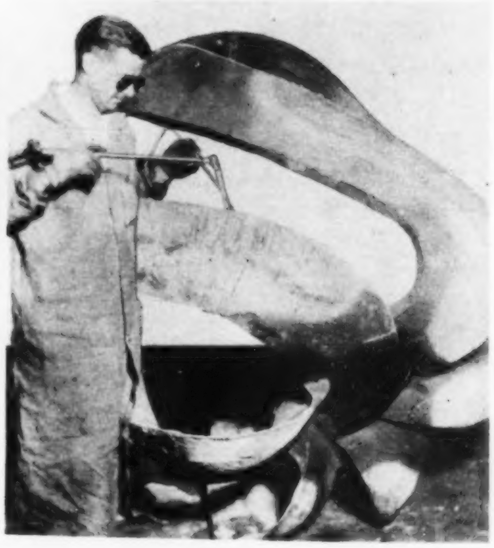
Unloading and erection were done by a 150-ton guy derrick with 150-ft. mast and 135-ft. boom, powered by a 12x14-in. double cylinder, triple-drum hoisting engine. For erection purposes the tower was equipped with two 8-in.-diameter lifting lugs on opposite sides, 2 ft. below the head seam. Additional pads were welded inside of the vessel at the point of attachment of the lifting lugs and connected by a built-up girder section to absorb the bending moment from the lugs.

A wire rope sling was looped around each lug and attached to the equalizing girder. The tower was lifted from a horizontal to a vertical position and then swung over the top of its structural steel support. Anchor bolts were inserted through holes in the base and the tower lowered to its final position. The total time required in lifting from the horizontal position on the cribbing until the load block was disconnected was 3 hr.

Wear of Machine Parts Reduced by HARD FACING

By C. C. PENDRELL,
Haynes Stellite Co., Los Angeles, Calif.

CLAMSHELL BUCKET LIPS show wear of only ½ in., in five months, after hard-facing, as compared with wear of 1¼ in. during same period when untreated.



DREDGE CUTTER BLADE had life increased from six weeks to 10 months by hard-facing, which saved cost of four new steel cutters.

(Extracts from address at Western Metal Congress)

SWIVEL FIXTURE and copper plate clamped to nose of plowshare enable operator to hard-face many units daily. Hard-faced plowshares last from three to five times longer than plain steel shares.

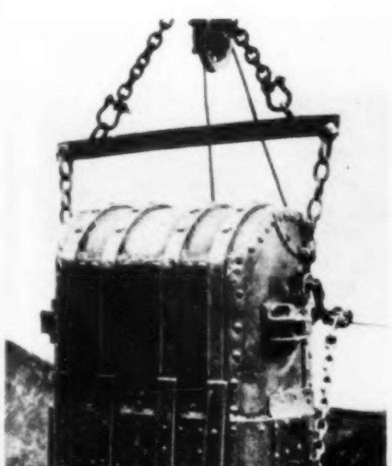
NO ONE HARD-FACING MATERIAL can satisfactorily do every job. In some applications, little or no shock or impact is encountered, but friction is tremendous. Here, the best material may be tungsten carbide; or, if a very smooth bearing surface is necessary, or corrosion resistance is needed, or homogeneity is a requirement, the cobalt-base non-ferrous alloys are best. On the other hand, if the application is one like a stone crusher, where a maximum of resistance to shock is a prime requisite, a tough austenitic alloy, which will work-harden, may be the solution. Every metallic material is to some degree a compromise between extreme wear resistance and great toughness. Alloys now in use as hard-facings cover almost the entire range; tungsten carbide diamond substitutes represent the hardest materials available and iron-base alloys the toughest.

Essentially there are five groups of true hard-facing materials, all having widely different compositions. These are, in the order of increasing wear-resistance: Alloy steels containing up to approximately 20 per cent of alloy constituents; iron-base alloys containing more than 20 per cent alloying constituents; non-ferrous cobalt-chromium-tungsten alloys; crushed tungsten carbide diamond substitutes, which, after welding, are embedded in a steel binder; and cast tungsten carbide inserts. This is the order of their wear resistance; the order of their toughness is approximately the opposite.

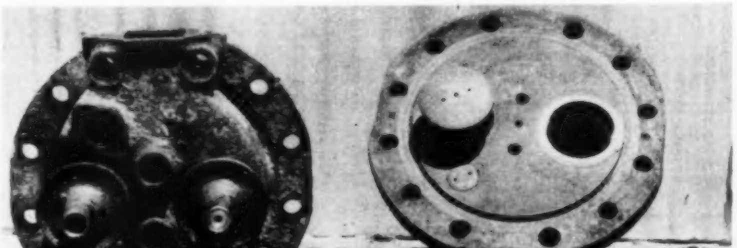
The accompanying illustrations show a few of the ways in which these alloys are being used. Dredge parts, including bucket pins, bottoms, lips and eyes, are hard-faced with iron-base alloys. Hydraulic dredge valves also are hard-faced successfully. In one case, a valve, after being hard-faced on the seat with a chromium-manganese-iron alloy, lasted four times as long as before. The hard-facing cost only a fraction of that of a new valve. Rotary cutter blades of suction dredges are usually hard-faced.

The iron-base alloys also are used successfully in rock crushing and screening equipment, while one of the most common applications for these alloys is dipper bucket teeth. Hard-facing of oil-well drilling and coring bits has been one of the principal factors which contributed to the economy of the deep holes recently drilled.

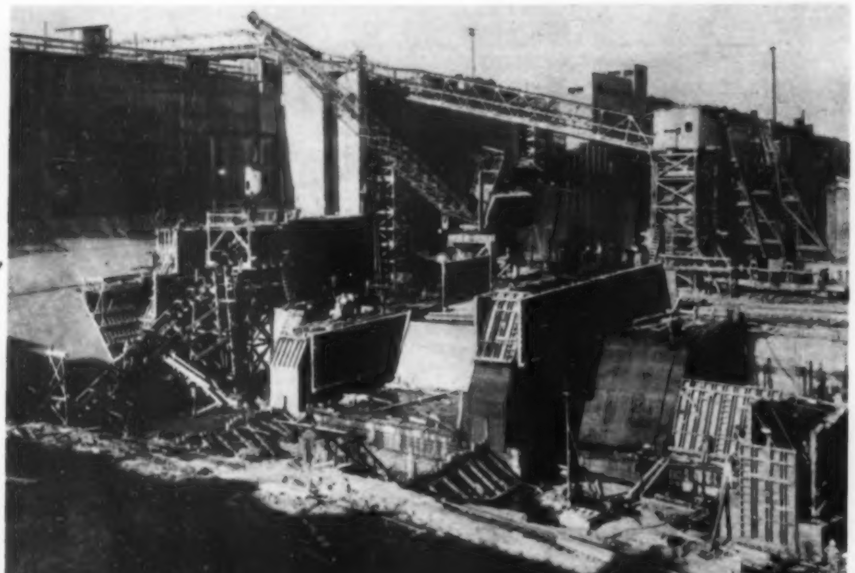
Probably the most important development in hard-facing in recent years has been standardization by many equipment manufacturers on the application of hard-facing materials to new parts before they are marketed to the trade. Valves for high-temperature steam and for oil refineries are furnished with alloy-trimmed seats. Pumps are furnished with hard-faced impellers and shaft sleeves. Most of the heavy-duty gasoline engines now on the market are equipped at least with hard-faced exhaust valve seat inserts.



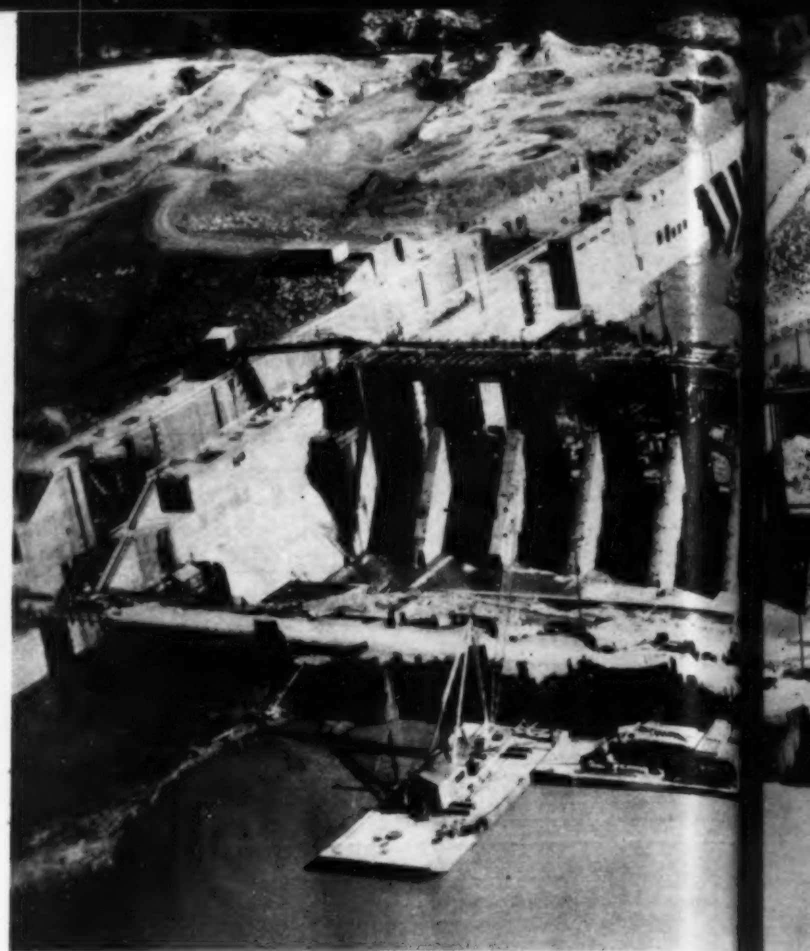
LIP OF DRAGLINE BUCKET is in good condition after handling 600,000 cu.yd. of material.



HARD-FACED VALVE SEATS in 250-hp. gas engine are in good condition after 16 months service. Formerly cast-iron valve seats lasted only from six weeks to three months before refinishing.



CONCRETING SPILLWAY SECTION, next to completed navigation lock, with bottom-dump bucket on boom of gantry-mounted revolving crane. Beyond reach of crane boom concrete is delivered to apron blocks by chute from elevated hopper. At right, bridge carries belt conveyor across lock to receiving tower.



Three-Stage Construction

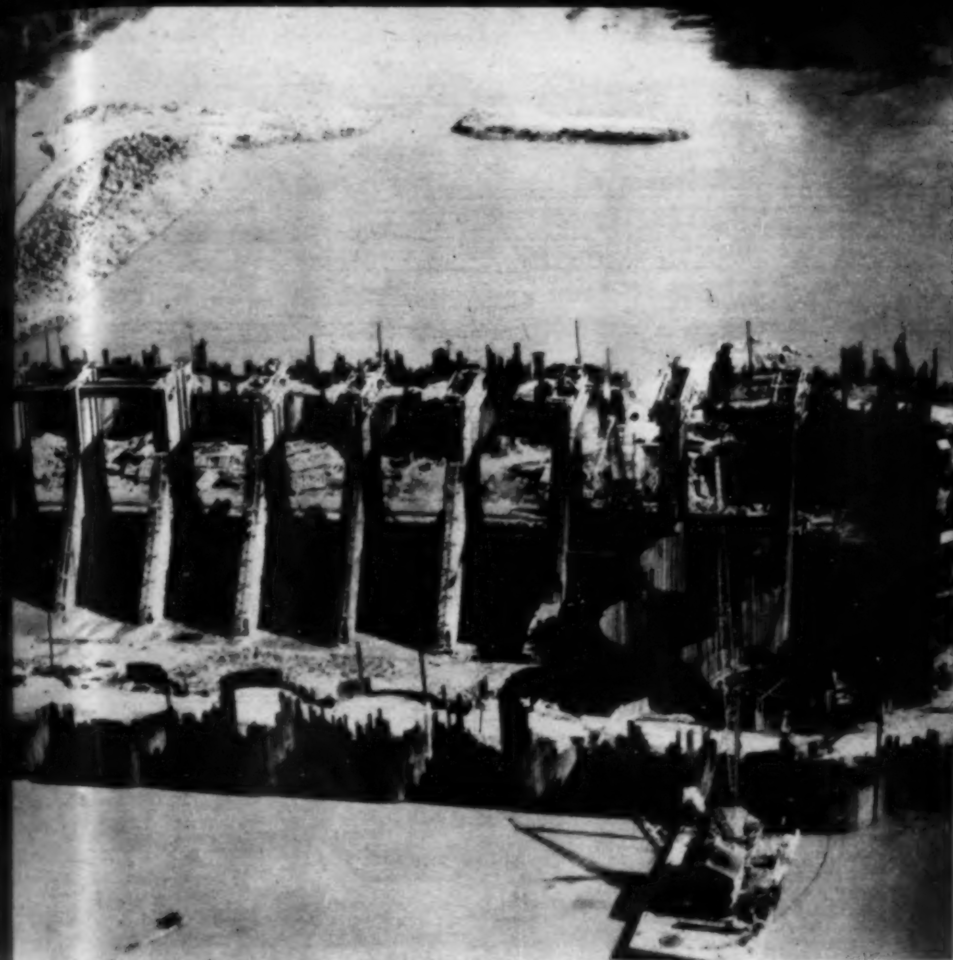
For Chickamauga Dam

UNCERTAIN CONDITIONS due to considerable depth of the rock foundations of Chickamauga dam, being built across the Tennessee River by the Tennessee Valley Authority, coupled with the possibility of major floods during the three years the project will be in progress, largely determined the program of operations and the construction plant adopted. Preliminary work was started early in 1936 and has been carried on according to the original plans, with the estimate that the project will be completed early in 1939.

General Features — At the site of the dam the Tennessee River has a wide flood plane on both sides of its channel, with rock underlying the entire vicinity. Across the channel is being erected a mass concrete spillway, which is 960 ft. in length and has a maximum height of 54 ft. Flanking this spillway at one end is a 60x600-ft. navigation lock, with a power house at the opposite end. Extending from the lock to high ground is an earth embankment, 1,370 ft. in length, with an embankment 2,871 ft. long connecting the power-house structure with high land at that end of the dam.

Plan of Operations — In order to provide capacity at all times for pass-

FOUNDATION for embankment core wall at south end of dam is uncovered by draglines loading into pneumatic-tired dump-wagons.



SECOND COFFERDAM in three-stage plan of construction incloses area for spillway construction. At left is completed 60 x 600-ft. navigation lock.

CUTOFF TRENCH is excavated for core wall of 2,900-ft.-long embankment flanking concrete navigation lock.

ing across the site all except very unusual floods, the project has been built in three stages. First, the navigation lock was completed in a cellular sheetpiling cofferdam. Next, most of the spillway section was built in a second cofferdam of that type, the stream being shunted around the end of this cofferdam while operations within it were in progress. Finally, a third cofferdam inclosing the site of the power house was built and the stream handled over the completed sections of the spillway.

Extensive Grouting— Because the rock underlying the site was badly broken and fissured to various depths, deep excavation was necessary. Unusually extensive cement grouting also was done to make the foundation watertight from end to end of the 5669-ft. project. In addition to the permanent cement grouting, hot asphalt was pumped into crevices and fissures upstream and downstream from the foundation of the dam proper to cut off the flow of water into the cofferdams. With one pipe inside of another, it was possible to keep the asphalt hot with steam under pressure so that the asphalt could be pumped to fill the voids and practically cut off the flow into the cofferdams while they were unwatered.

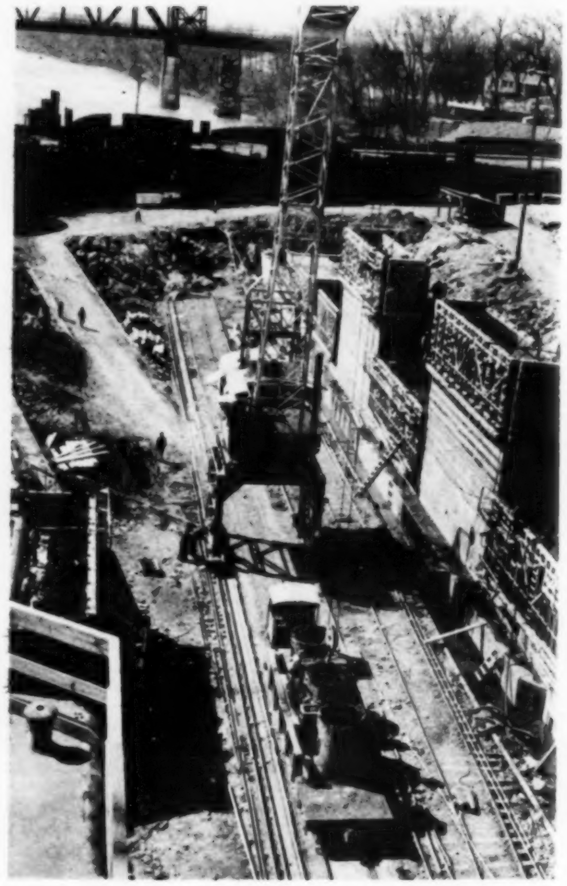
Concrete Mixing and Handling— Sand, stone and cement for the 448,000 cu.yd. of concrete involved in the project were delivered by rail to a central mixing plant in a tower on the bank near the navigation lock. In general this plant was designed and equipped like the mixing plant used in building Norris dam; in the plant for the Chickamauga project, however, only two 2-yd. mixers were installed.

Concrete Delivered by Belts—Concrete has been handled by conveyor belts from this central mixing plant to transportation equipment by which it is delivered to the point where operations are in progress. During the construction of the lock the belt conveyor supplied an overhead bin from which concrete was fed into bottom-dump buckets handled on flat

FIRST COFFERDAM, in three-stage construction plan, incloses area for construction of navigation lock. Cofferdam walls are formed by steel sheetpile cylinders filled with material dredged from river.

GANTRY CRANE with special crooked boom raises concrete bucket to point of discharge into forms for spillway piers.

HOT ASPHALT (left) is pumped into rock crevices, with double-pipe steam system, to cut off subsurface seepage of water at foundation of dam.



DELIVERY OF CONCRETE (right) to traveling gantry crane is done by flat cars carrying bottom-dump concrete buckets.

cars operating on tracks between the lock walls. A traveling gantry shifted these buckets to the point where forms were being filled.

After the lock was poured and operations started on the spillway section in the second cofferdam, the belt conveyor was extended across the lock to a receiving bin in a tower at the adjacent end of the spillway. The same system of buckets on flat cars, working in conjunction with a traveling gantry, was used in pouring the concrete for the entire spillway.

When the third cofferdam was completed early in 1938 the belt conveyor for handling concrete was extended to deliver concrete into it from the central mixing plant. With concrete being moved more than 1,200 ft. in this manner, by belt, no difficulties were experienced. The volume that could be handled also was more than ample to keep the delivery equipment fully supplied at all times.

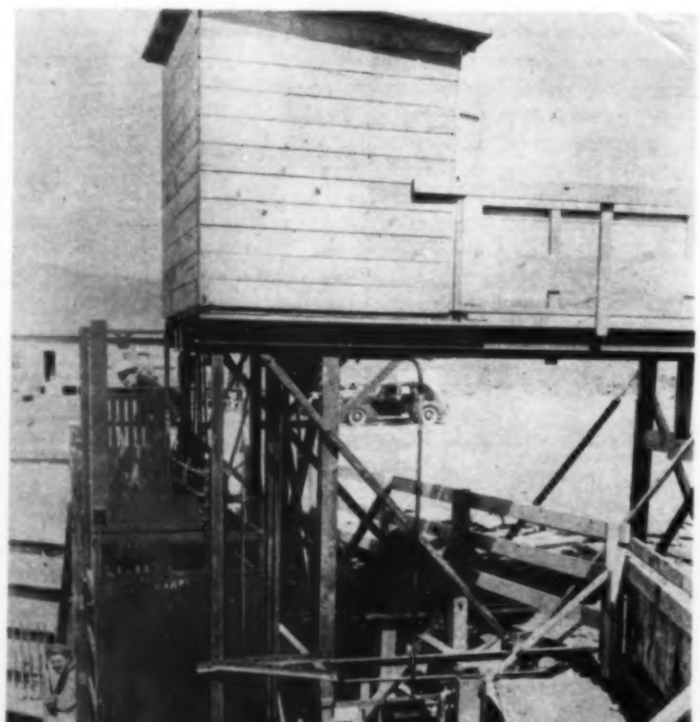
Embankments — As shown in one of the accompanying photographs, the excavation necessary to find satisfactory foundations for the concrete core wall in the two earth embankments of the project was made under difficult conditions. This work was all done in open cut, with slopes of 1 to 2 or flatter, the maximum depth from 75 to 80 ft. for some distance.

On account of the stratified and broken rock encountered, much of the core wall for the embankment flanking the lock had to be poured piecemeal in short sections. On the opposite side of the river the excavation for the core wall also had to be carried down through earth, sand and gravel carrying a heavy flow of water in some places. By grouting the foundation before the trench was dug, pumping was much reduced.

Personnel — T. B. Parker is chief engineer and C. A. Bock is chief consulting engineer of the TVA. In direct charge of operations on the Chickamauga dam is Lee G. Warren, project engineer, with J. B. Hays, construction engineer and F. C. Schlemmer, construction superintendent.

Shaft Elevators Made Safe *At Ft. Peck Dam*

IN PREPARING for work on the final major contract at Fort Peck dam on the Missouri River in Montana, the Fegles Construction Co. is leaving nothing to chance in guarding against safety hazards that might arise during work of installing cylindrical type main control gates this season. Their latest move toward safety was the installation of two automatic push-button type elevators for raising and lowering men in the concrete-lined, 50-ft.-diameter control shafts connecting with the diversion tunnels. These elevators, one installed in Shaft 2 and one in Shaft 3, are of the type one may expect to find in a modern, 20-story building. They are designed to carry a load of 1,200 lb., with a safety factor of 8; in other words, they are capable of carrying 9,600 lb.



Equipped with all-steel cages, safety doors with automatic locks, and electrical push-button controls in the cages and at each landing, they will afford the safest means of transporting men in the 240-ft. shafts. Each cage is large enough to hold 6 passengers. The automatic door locks are the same type as those used on passenger elevators in large buildings. No door to the elevator shaft can be opened unless the cage is stopped at that particular landing, and the cage can't be moved if any of the doors is open. The contractor believes the equipment is safe even when operated by an inexperienced person and will aid him in making a good safety record on his job.

When completed by U. S. Army Engineers, Fort Peck dam will be the world's largest hydraulic fill, containing more than 100,000,000 cu.yd. of material.

ALL-STEEL ELEVATORS (left) in 240-ft. deep control shafts carry 7 men safely. Powered by 7½-hp. motor, cages operate at speed of 100 ft. per minute, up or down.

Passing the Buck

WHERE JOB CONDITIONS ARE UNCERTAIN ENGINEER MAKES CONTRACTOR HOLD BAG

By G. HOCKENSMITH, Sr.
President,
Hockensmith Contracting Co., Inc.,
Albany, N. Y.

SINCE 1908 I have been in construction work and, during this period, have built bridges, dams, irrigation systems, buildings and many other large structures. Each year, in all this work, I have noticed a great change taking place. The contractor, the designing engineer and the supervising inspector have been growing farther apart.

Besides drawing up plans, the designing engineer formulates a set of specifications which become a part of the contract and which serve to cover any errors that may have been made in the plans. Consequently, it takes a battery of attorneys, judges and juries to determine who is right in case of controversy. If, in the first place, specifications were drawn up in simple terminology, stating that the contractor is to do or not to do a specific duty and that, if he does it, he gets paid for it, all of the intricate court proceedings would be eliminated.

Core Borings

As an example, a contract is to be open for bids, and a set of plans with specifications is furnished each bidder. Regarding the foundations, the designer previously must have made borings to determine the foundation design and to estimate the load per square foot the material will carry, yet invariably the bidders find notes on the boring plans stating that the engineers will not guarantee the findings which the borings indicate. The bidder, with limited time at his disposal, is called upon to assume full responsibility for explorations to determine the character of material 50 ft. below the surface, while the designing engineer, who has had, perhaps, six to twelve months to examine the site, with ample money to make complete borings, already must know positively where bedrock is, but he still will not guarantee his findings.

Contractors, with from 2 weeks to 30 days available for inspection prior to entering bids, do not have sufficient time to make a thorough investigation. Naturally, they rely on the accuracy of the findings given in the boring plans because they believe, first, that the designer *must* know the nature of the material before he can design his foundations; second, that he has had ample time and money to make his search; third, that he knows what he has been hired to know or find out; and, fourth, that contractors can rely on the engineering firm's integrity.

Even with all this in mind, contractors still find that days and nights are spent drafting specifications and contracts to hide errors which designers may have made and to place the gamble entirely on the shoulders of the unsuspecting bidder, regardless of whether conditions change or not. In any case, the contractor must foot the bill.

Cases have arisen in which bedrock was shown on the plans at a certain elevation, where the designer indicated rock channeled out for the foundations. When the contractor excavated to that depth, no bedrock was found; it was reached at a much greater depth. After long delays and arguments, changes were made to meet the actual conditions, and the contractor was asked to finish his work at the unit price bid per cubic yard, although the necessary change often entailed additional cofferdams and greater expense in pumping, for all of which no compensation was allowed. The contractor's only recourse was to go to court.

Hidden Obstructions

Sometimes, in foundation work, obstacles are encountered by the contractor, such as sunken boats and timber cribs; but, when borings in these locations were taken previously by the designing engineer, the latter moved his boring apparatus to different locations and made no report of the striking of such obstacles to the bidders. The designing engineer having knowledge of these hidden obstacles should report them in such a way that their presence will be brought home to the contractor. If such knowledge is not made available to the bidders, the contractor proceeds with his work unsuspectingly, and the obstacles entail great expense and delay. Despite his negligence in reporting obstacles, the designing engineer who discovered them is assumed to be protected by a clause in the specifications which requires the contractor to satisfy himself that the work can be carried on according to the plans. This assumption, of itself, may lead to litigation.

In my experience, I have done work for engineers who made reasonable adjustments in contracts as soon as unsuspected obstructions were encountered, simply because they realized that lack of complete preliminary information was no fault of the contractor and that he should be compensated for the extra work. Also, I have done work for other engineers who knew in advance of hidden structures but gave no notice to warn the bidders. The only answer one could get from this breed of designing engineer was, "Read your specifications and complete the job; we will pay you nothing for the additional expense to you."

A complete set of borings is the key to successful foundation work. Knowledge gained from studying the borings makes it possible for the engineer to design the foundation properly. When a contractor makes a study of the borings, he should be able to tell what method should be used and the cost of building the project. Probably 90 per cent of court cases between designing engineers and contractors are caused by incomplete core-boring plans.

Foundation Piling

Another gamble is forced on the contractor when it is specified that foundations shall rest on piling. Specifications require the contractor to bid so much per lineal foot of piling in place. No one tells him what length piling will be required, but the contract states that he will be paid so much for pile to be driven as test pile, if so ordered. Almost invariably, when the contractor starts work he must determine the length of piling at his own expense, as the engineers will not order him to drive test piling and will insist that piling of various lengths be on the job at all times to meet the conditions.

Specifications may state that wood piles must carry 15 tons each. The inspector will watch the driving of the piling, so many blows of the hammer per inch of penetration. If a pile is 10 ft. too long, the contractor loses the cutoff. If the pile is 1 ft. too short, he loses the total length of piling, and a new pile is inserted in its place.

Engineering Competency

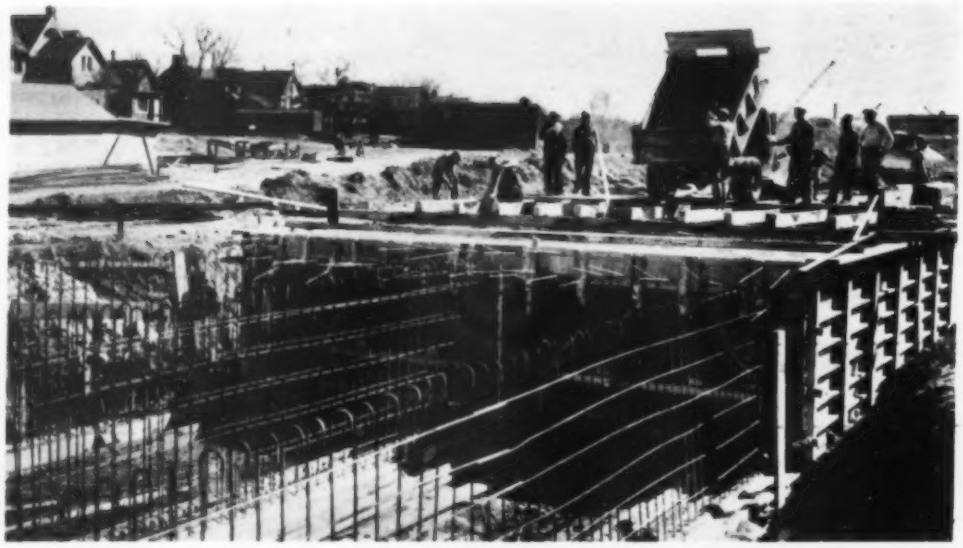
Both the designing engineer and the contractor are human beings and should act as such. I have often heard contractors remark that when a certain designing engineer's name is mentioned they raise their prices 25 per cent to do the work. This price increase does not mean that the engineer gets a better job, but it does mean that he is just naturally a hard man to work for and demands the unreasonable. Designing engineers with a reputation for knowing their jobs are the easiest men to work for, and they get their work done at lower cost because it is a pleasure to work for and with them.

Years ago, the man in demand was the "Jack-of-all-trades;" but the construction field now has advanced to a stage that demands specialization in individual lines. If a large structure is to be erected, one finds designing engineers, foundation experts, structural steel experts, reinforced-concrete experts, planning experts, heating and lighting experts, architectural experts, all employed. When a contractor builds a structure that is planned and designed by these experts, he does not find it a difficult job because each man knows what he is doing and avoids error. However, when a contractor builds a large job that is handled by one "expert" in all lines (the Jack-of-all-trades), he generally finds himself in plenty of trouble, and so does the designing engineer. The contractor is at the mercy of the designing engineer and, if both parties are not fair, a disagreement means a court settlement, which is always unsatisfactory to both sides. It has often been proved in my experience that the bigger the engineer, the easier the job. When unforseen conditions do arise, both parties sit down around a table and adjust differences in a few minutes, eliminating recourse to the courts.

A contractor, if he does anything, is bound to make mistakes, and he must pay for his mistakes. If a mistake is made by a designing engineer, he generally is covered by the specifications, and the contractor can be made to stand the expense. It is no crime to make an error, and a big man readily admits his mistakes. Both parties should be big enough to pay for their own errors in construction work.

Steel Sewer Forms

Carry Truck Roadway



STEEL FORMS for double-box storm drain with barrels 12 ft. wide by about 7 ft. high carry plank runway over which trucks back into place to dump concrete. Wall reinforcement is erected in advance of form moving.

TO AID SETTING of wall reinforcement, carpenters erect wooden rack which will support bars until invert concrete is placed and horizontal rods are tied.

STEEL SEWER FORMS used in building a long double-box culvert at Port Richmond, Staten Island, N. Y., support a plank roadway over which end-dump trucks back into position to deposit 1-yd. loads of concrete hauled from a central mixing plant on the project. The forms carry the roadway and trucks without distress. Narrow right-of-way and unstable soil conditions in the rubbish-filled marsh where the sewer is being built make it advisable to use the roof of the completed culvert as a roadway for the trucks.

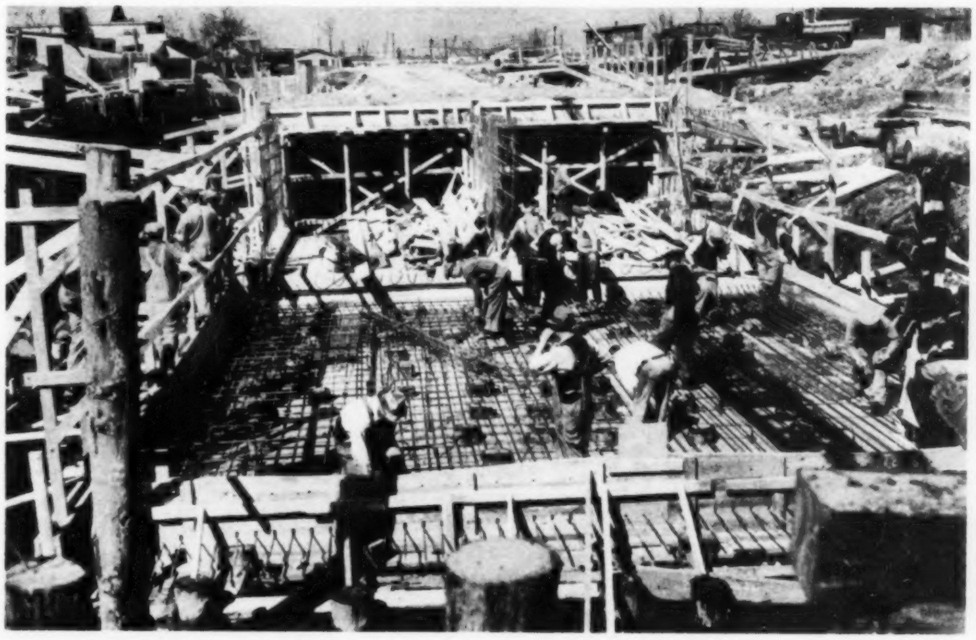
Concrete is placed in 30-ft. sections of the double-barrel sewer. Trucks start dumping at the outer end of the forms, and the plank roadway is taken up as the forms fill with concrete. Exterior vertical forms 8 ft. 4 in. high, on which the plank roadway rests, are tied by spreader bolts to the interior forms but are not braced against the bank.

Maximum outside dimensions of the structure, designed to carry storm water, are 29 ft. wide by 10 ft. 8 in. high. Each of the two barrels has inside dimensions of 6 ft. 11 in. by 12 ft. Concrete for a 30-ft. section of invert or arch amounts to about 100 cu.yd. The invert rests on a plank deck supported by 2x10-in. ribbons spiked to 30-ft. timber piles driven across the trench at 2-ft. 4-in. and 3-ft. 8-in. spacing in bents placed 3-ft. apart.

Two Types of Forms — Work on the project started at about the center of its 700-ft. length, where right-of-way was first available, and proceeded in two directions from that point. Blaw-Knox traveling steel forms are used at one end and wood forms at the other. Sewer construction with the wood forms is slower and less convenient than with the steel forms. Trucks cannot operate on top of the wood forms but have to approach each 30-ft. section by a temporary bridge across a diversion channel which bypasses a creek around the work. The wood forms, furthermore,

PLANK RUNWAY (left), rests on timber crossbeam and stringers supported by outside wall forms. Planks are taken up as filling of forms progresses.

DIRECTING CONSTRUCTION of sewer project for WPA are H. TRACY MARTIN **(left),** general superintendent; JOSEPH GALASSO, steel foreman; M. BRACH, superintendent.



WOOD FORMS used at one end of sewer lack capacity to carry trucks and require vehicles to approach structure over temporary timber bridges at right, adding to difficulty of placing concrete. Steel crew sets invert reinforcement on timber piles.

have to be braced from the unstable banks of the trench.

At both ends of the sewer, after invert has been poured, reinforcing steel for the outside walls and dividing wall is erected before either steel or wood forms are moved forward. Wooden racks erected by carpenters aid the steel setters in placing wall reinforcement. The racks are removed before the forms are brought forward.

Steel forms are pulled ahead on steel rails by a 20-hp. tractor operating on top of the sewer or on the bank. A hauling line passes from the forms to the tractor through a pulley anchored to a U-bar cast in the invert.

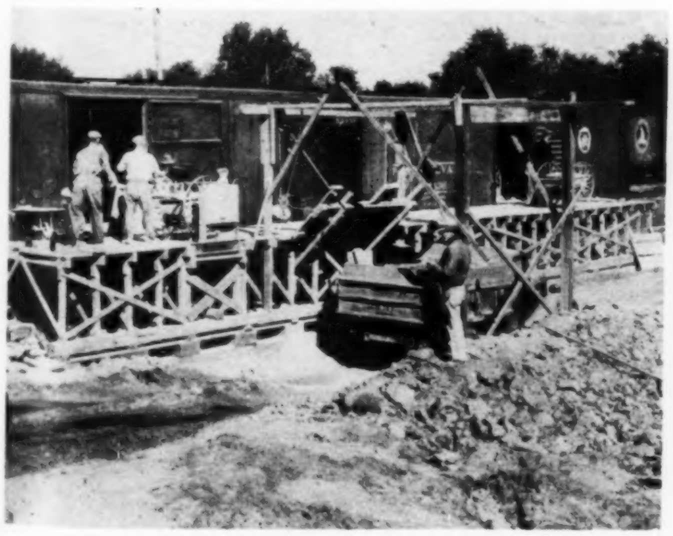
Concrete Plant — A mixing plant equipped with 15-yd. overhead bins, weighing batchers and a 1-yd. mixer turns out the concrete for the sewer. In good weather the job makes a 100-yd. pour each day, or five pours in a 5-day week. A steam crane with a 1-yd. clamshell bucket handles aggregates into the bins.

Low temperatures did not stop concreting during the cold months. The organization used high-early-strength cement and heated concrete ingredients and forms to keep men at work in all weather. For cold-weather concreting the steel forms had an advantage in that they could be kept warm without danger of catching fire while concrete was being placed and during the night. Two coke-burning salamanders were set inside the forms to maintain uniform heat and avoid sudden temperature changes throughout the placing and curing of concrete. The steam crane at the mixing plant kept live steam in the bins all night and shot steam into them during the day when it was not busy loading.

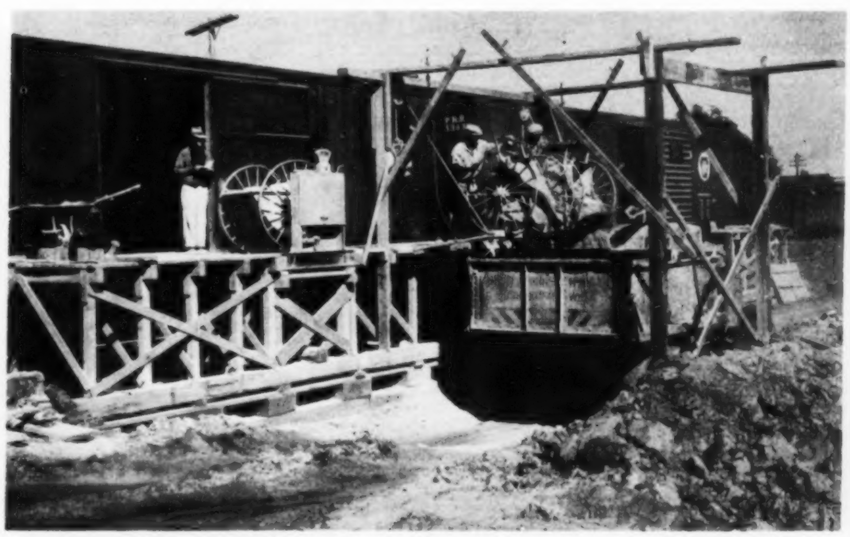
Ordinarily about 75 men are employed per day for all operations from excavating to concrete finishing. The sewer is being built by WPA forces, the bulk of the work being performed by skilled mechanics. Mechanics are paid the prevailing wage and are under competent supervision, resulting in a low-cost concrete in place, ranging from $6 to $9 per cubic yard, despite the fact that considerable unskilled labor is necessarily included in the WPA roster.

Administration—To expedite progress, simplify supervision and facilitate transfer of men, equipment and materials, WPA jobs in New York City, under the direction of Lieut.-Col. Brehon B. Somervell, Corps of Engineers, U. S. Army, have been segregated into construction units known as Work Projects. The sewer at Port Richmond is one of four jobs running concurrently in Work Project RS4 under the general supervision of Edgar A. Groves, field office manager for the Borough of Richmond. H. Tracy Martin is general superintendent. Operations at the sewer are directed by M. Brach, superintendent.

Drawbridge for Bulk Cement Loading



RAISED BY COUNTERWEIGHT, drawbridge allows truck to drive into depressed roadway alongside loading platform.



WEIGHT OF BUGGY, loaded with cement, depresses drawbridge and allows dumping into batch truck compartment.

COMPARATIVE COSTS OF APARTMENT BUILDINGS

By ARTHUR F. COMSTOCK
*Formerly Chief Estimator,
James Stewart & Co., Inc., Contractor,
New York, N. Y.*

IN MULTI-STORY BUILDING CONSTRUCTION we have few classes of structures more standard than apartments. Still there are variations in cost from approximately 30c. to 90c. per cubic foot in New York City, depending upon type of construction, shape of building, materials selected, character of facilities and architectural treatment. In the higher brackets, say above 60c. per cubic foot, in which might be termed the luxury class, there has been little construction activity in recent years.

These notes have been prepared with the idea that a frank analysis of the more common types in the low-price field might be of interest. Accordingly, three types of construction have been selected, as shown in the accompanying table: non-fireproof; bar joist (fire-protected); and fireproof. The cost of each has been broken down into its constituent items or trades and shown both by amount and cubic foot of building in parallel columns, as of Jan. 1, 1938 under New York City conditions.

The writer is fully aware that two buildings, even though of identical design and built at the same time by the same builder, will not cost exactly the same. Besides, different architects emphasize different features and materials, room sizes vary, ceiling heights differ, and some builders are more efficient than others, so that, all in all, we must be prepared for variations in the cost of each type. While an effort has been made to choose examples which fairly represent the types involved, attention is called to the fact that the average size of rooms is not the same in all three cases, and that some small allowance should be made in comparing one with the other, since smaller rooms mean higher cost.

Specifications

Non-Fireproof Building: Concrete footings, brick walls, common brick facing, brick window sills, cast stone copings, double-hung wood windows, short-span cinder concrete arches and steel framing on first floor, wood joists on steel beams and columns above first floor, gypsum partitions in basement, wood partitions above first floor except brick around stairs and elevators, wood doors except kalamein for corridors, combination metal backs, wood furring of exterior walls and metal lath on walls and ceilings. Floors generally wood over sub-floor, corridors terrazzo, steel stairs cement filled. Attic ceiling insulated with rock-wool. Heating system is one-pipe steam, oil-fired boilers.

Bar-Joist Building: This type has only recently been admitted under the New York Building Code. Steel skeleton frame, concrete footings and basement walls, 4-in. brick facing and 6-in. backup tile in exterior walls, terra cotta coping, steel residential casement windows, metal sills, hollow tile and 2-in. solid plaster partitions, top lath and 2-in. concrete over bar joists with monolithic finish, ceiling lath attached to bar joists, combination metal bucks, wood doors except kalamein for corridors and metal furring of exterior walls. Floors generally wood laid on mastic, corridors terrazzo, steel stairs cement filled. Heating system is two-pipe steam, oil-fired boilers.

Fireproof Building: Concrete footings, concrete basement walls, 13-in. brick exterior walls, common brick facing, terra cotta coping, brick window sills, steel frame, steel residential casement windows, metal sills, hollow tile partitions, short-span cinder concrete arches, combination metal bucks. Doors and floors same as for the non-fireproof building. Heat-

Typical New York City Apartment Houses

SHOWING COST COMPARISON OF DIFFERENT TYPES, AS OF JAN. 1, 1938

	Non-Fireproof Wall Bearing		*Bar Joist Steel Frame*		*Fireproof Steel Frame, Sh't Sp. Arches, Cinder Conc.*	
No. Stories	5 & Bas't		9 & Bas't		12 & Bas't	
No. Rooms	580		415		1400	
No. Aparts.	145		125		350	
Floor to Floor Ht.	9 ft. 6 in.		9 ft. 4 in.		9 ft. 4 in.	
Cu.Ft. per Room	2940		3600		2560	
Total Floor Area	180,000		153,000		408,000	
Cube	1,700,000		1,500,000		4,000,000	
	Total	*Per Cu.Ft.*	*Total*	*Per Cu.Ft.*	*Total*	*Per Cu.Ft.*
1. Excavation	$ 9,000	$0.0053	$ 8,200	$0.0055	$ 60,000	$0.0150
2. Concrete Foundations	10,400	.0061	17,000	.0113	92,000	.0230
3. Brickwork	78,000	.0458	53,700	.0358	195,000	.0488
4. Tile Partitions	7,000	.0041	9,000	.0060	105,000	.0262
5. Rough Carpentry & Set Millwork	39,000	.0230	20,700	.0138	42,000	.0105
6. Millwork (Fin'd Carp'y)	18,000	.0106	14,700	.0098	32,400	.0081
7. Concrete Arches	7,200	.0042	24,000	.0160	116,000	.0290
8. Cement Work	7,000	.0041	12,600	.0084	49,600	.0124
9. Bar Jsts., Top Lath & Concrete	—	—	30,000	.0200	—	—
10. Wood Windows & Caulking	5,500	.0032	—	—	—	—
11. Steel Windows & Caulking	—	—	9,300	.0062	22,000	.0055
12. Hollow Metal & Kalamein	13,000	.0076	12,300	.0082	60,800	.0152
13. Structural Steel	15,200	.0089	57,400	.0383	224,000	.0560
14. Misc. & Ornamental Iron	14,800	.0087	10,200	.0068	24,000	.0060
15. Sheet Metal & Roofing	5,200	.0031	4,200	.0028	10,400	.0026
16. Plastering & Lathing	77,000	.0453	83,500	.0556	155,000	.0388
17. Glass & Glazing	1,900	.0011	6,000	.0040	4,000	.0010
18. Painting	17,900	.0105	17,100	.0114	46,400	.0116
19. Finish Hardware	6,000	.0035	6,100	.0041	14,800	.0037
20. Finished Wood Floors	17,600	.0104	20,200	.0136	56,000	.0140
21. Ceramic Tile	14,000	.0082	11,800	.0079	32,000	.0080
22. Bathroom Accessories	1,200	.0007	900	.0006	3,200	.0008
23. Terrazzo	2,700	.0016	3,500	.0023	8,000	.0020
24. Waterproofing & Dampproofing	2,800	.0017	2,400	.0016	12,400	.0031
25. Weatherstrips	1,500	.0009	—	—	—	—
26. Linoleum	2,800	.0017	3,900	.0026	7,600	.0019
27. Medicine Cabinets	1,300	.0008	1,100	.0007	3,600	.0009
28. Mail Boxes	300	.0002	300	.0002	800	.0002
29. Incinerators	1,400	.0008	600	.0004	1,200	.0003
30. Kitchen Cabinets	14,000	.0082	12,200	.0081	32,000	.0080
31. Gas Ranges	7,600	.0045	6,600	.0044	16,000	.0040
32. Refrigerators	13,800	.0081	11,900	.0079	34,000	.0085
33. Insect Screens	3,400	.0020	5,400	.0036	12,400	.0031
34. Window Shades	700	.0004	1,100	.0007	2,000	.0005
35. Plumbing	50,000	.0294	47,300	.0315	180,000	.0450
36. Heating & Ventilating	40,600	.0239	42,200	.0281	105,000	.0262
37. Electric Wiring & Fixtures	26,200	.0154	27,700	.0185	78,000	.0195
38. Elevators	25,000	.0147	12,700	.0085	52,000	.0130
39. Gen'l Conditions (Job Overhead)	20,000	.0118	22,800	.0152	64,800	.0162
40. Plant (Gen'l Contr's Only)	1,500	.0009	1,200	.0008	4,000	.0010
41. Insurance (General)	1,500	.0009	1,800	.0012	4,800	.0012
42. Contingencies, 1-½%	8,800	.0052	9,900	.0066	28,800	.0072
43. General Office Overhead	14,200	.0084	16,500	.0110	48,000	.0120
44. Fee-Commission-Profit	24,000	0.0141	30,000	0.0200	80,000	0.0200
	$629,000	$0.3700	$690,000	$0.4600	$2,120,000	$0.5300

ing system is two pipe steam, oil-fired boilers.

The excavation for all three buildings was in earth and there were no exceptional foundation problems. All kitchens had linoleum floors, and all kitchen cabinets were wood, pre-fabricated. Elevators were standard apartment house type, push-button control, with swinging shaft doors.

Item 42, "Contingencies," while often omitted, is intended to cover such unpredictable, but none the less real, costs as strikes, wage increases, etc. Items 43 and 44 are usually combined in one item. But Item 43 must be paid by the owner in some degree whether or not he employs a contractor.

In conclusion, the figures here given are not iron-clad, nor is it claimed that they apply generally to other buildings or to other localities. They are merely an exposition of the variations which constitute the differentials between different types of apartments under the particular conditions given.

Large Size Paving Brick

Reinforced With Steel Rods

A TEST SECTION of brick pavement 38 ft. wide by 75 ft. long, reinforced with steel rods, was installed in September, 1937, on West Grand Ave., Springfield, Ill. Instead of using standard paving brick in basket weave pattern, large vitrified units $3\frac{1}{2}$x8x8 in. were manufactured. They were laid by hand in checkerboard pattern, properly spaced, and $\frac{3}{8}$-in. reinforcing rods were placed in two directions in the cement-grouted joints between blocks.

The Ohio Highway Department and the National Paving Brick Association are planning another test installation in Ohio. A base course of the stabilized type will be used under some of the sections. This type of pavement will not require curbs or headers on the sides and, it is estimated, will be less expensive than the usual design. However, it is now only in the experimental stage.

LARGE-SIZE BRICK, measuring 8x8x$3\frac{1}{2}$ in., are laid by hand in checkerboard pattern, properly spaced by wood strip.

STEEL REINFORCEMENT, in form of $\frac{3}{8}$-in. deformed round bars, is placed in both directions in joints between brick, prior to grouting.

WORKERS force $\frac{3}{8}$-in. steel reinforcement bars into joint spaces with wood tampers.

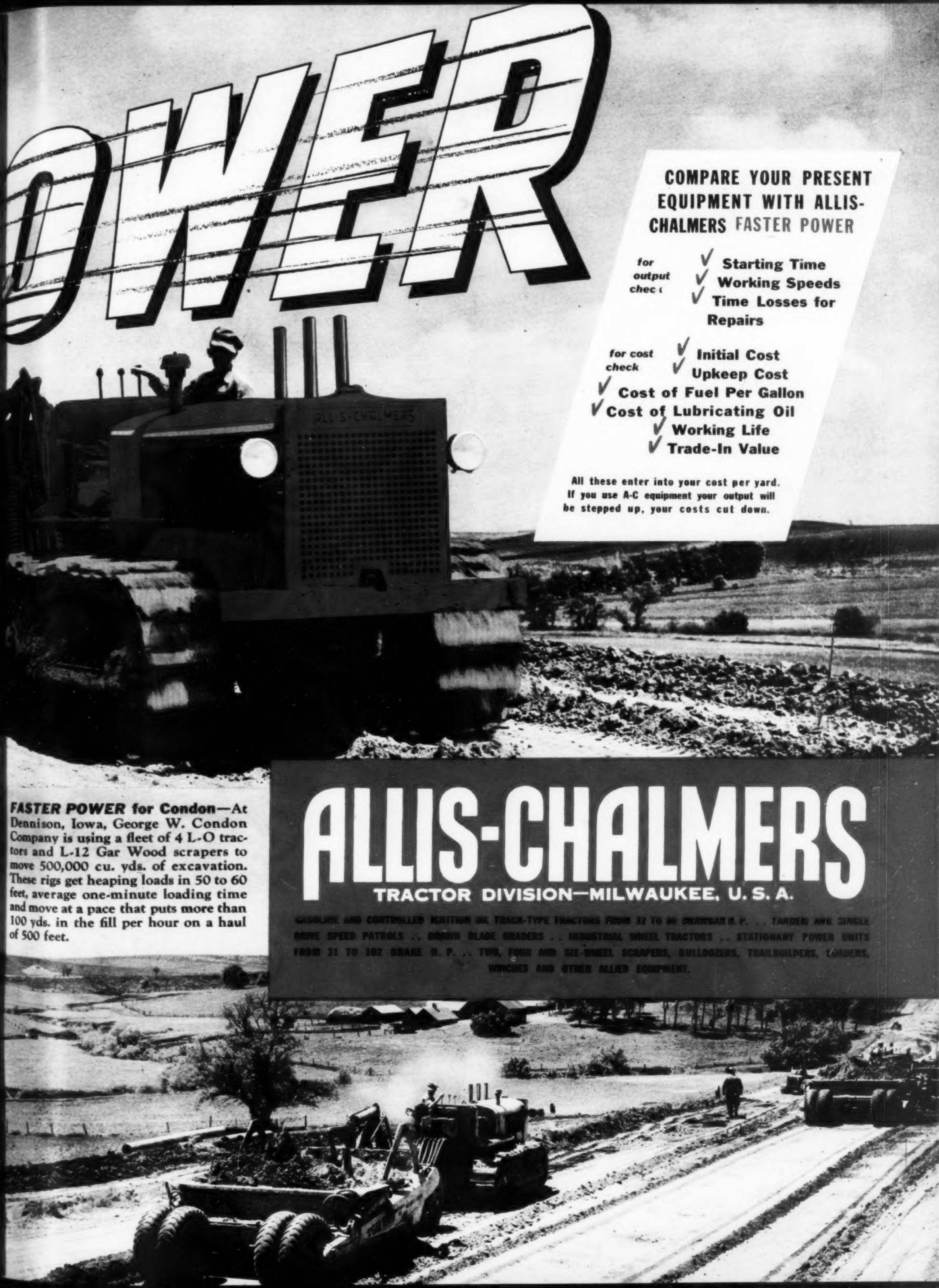
JOINT FILLER is a portland cement grout dumped on pavement surface and broomed into openings between large brick units.

MOVE *More* 9-YARD PAYLOADS EVERY SHIFT WITH FASTER P

Extra loads are gravy—profit. You can move plenty of extra 8-9 pay yard scraper loads every shift by using faster-moving Allis-Chalmers L-O tractors and L-12 Gar Wood scrapers. You gain from 1 to 3 loads per shift on starting time *alone,* because A-C tractors start instantly and go right to work. Quick pick-up and easier handling save you trip-gaining seconds getting into and out of the cut, swinging about on narrow fills, maneuvering in tight spots. More and higher speeds (up to 100 feet in .177 minutes travelling at 6.41 m.p.h.) enable you to gain as much as one 9-yard payload every hour on 700-foot hauls. Time this outfit against other rigs and prove for yourself that A-C's FASTER POWER will put you loads ahead on every shift. Check costs, too. In A-C oil tractors you get more power per pound of weight and pay less for it. You get smooth, steady operation day after day from any clean Diesel fuel or furnace oil, at savings up to 3c per gallon over premium Diesel fuels ... you use standard engine lubricating oils, save 20c or more a gallon. Maintenance and repair expense are remarkably low.

Ask your Allis-Chalmers dealer how FASTER POWER can step up your job and at the same time cut your costs.

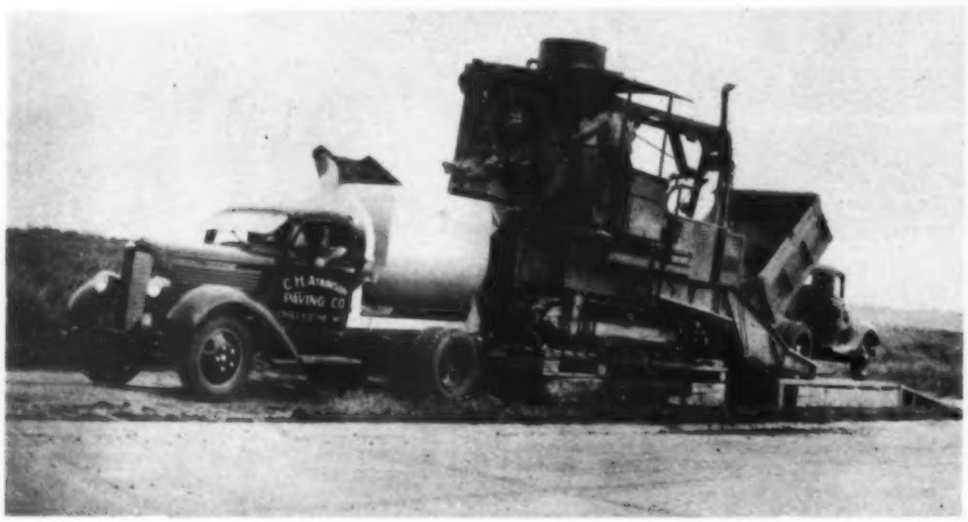
Saving an Uphill Return — Condon used this method of dumping into a ravine, thus avoided a stiff uphill return which would have been necessary had the fill been made from the bottom up.



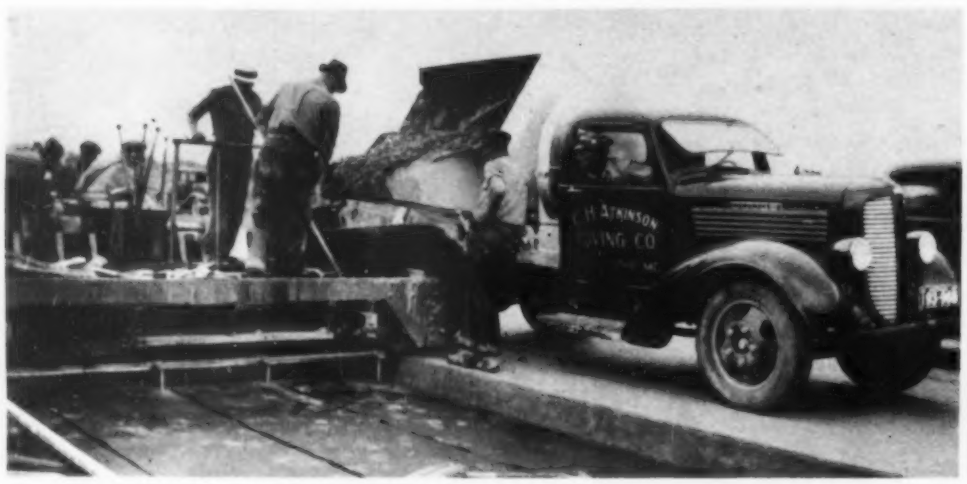
***FASTER POWER* for Condon**—At Dennison, Iowa, George W. Condon Company is using a fleet of 4 L-O tractors and L-12 Gar Wood scrapers to move 500,000 cu. yds. of excavation. These rigs get heaping loads in 50 to 60 feet, average one-minute loading time and move at a pace that puts more than 100 yds. in the fill per hour on a haul of 500 feet.

Paver Operates as CENTRAL MIXING PLANT *Serving Truck-Mounted Agitators*

PLATFORM (above), is placed under paver, operated as central mixing plant to raise discharge end for delivery into agitator body of transport mixer. RAMP **(below),** enables batch-trucks to dump into mixer skip.



FROM AGITATOR BODY concrete flows into trough of lateral distributor, equipped with screw conveyor.

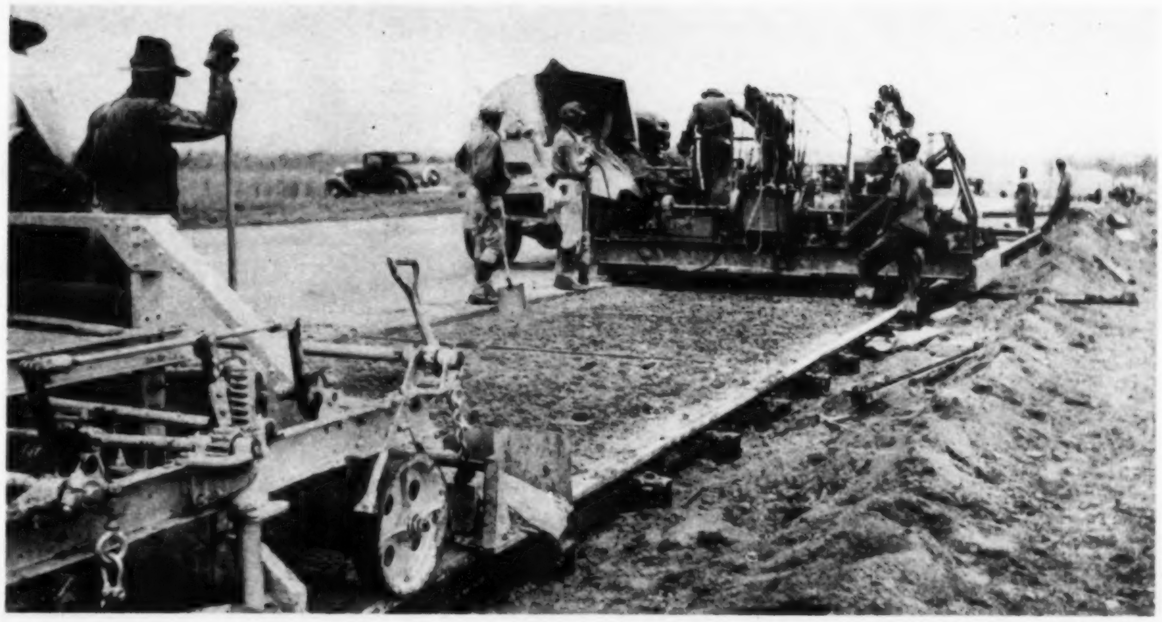


SIDE-DISCHARGE facilitates delivery of concrete from transport agitator into lateral spreading trough.

SCREW CONVEYOR in spreading trough distributes concrete across 10-ft. width of subgrade for slab.

IN WIDENING U. S. Route 66 near St. Louis, Mo., the C. H. Atkinson Paving Co., of Chillicothe, Mo., because of special job conditions, adopted the expedient of using a standard concrete paver as a central mixing plant serving a fleet of three 2-yd. stationary-drum type agitators, mounted on light trucks. The contract called for converting the existing 3-lane, 30-ft. concrete pavement into a 4-lane route 40 ft. wide, with lip curb. The widened section was a 9-7-9-in. thickened-edge slab, 10 ft. wide.

The subgrade was barely wide enough to accommodate a 27-E paver, the minimum size allowed under the specifications, and the paver could not have been operated without squeezing forms out of line in soft material. In addition, the design called for drop inlets instead of shoulder drain basins. It was, therefore, practically impossible to operate the paver, to say nothing of handling the batch-trucks, on the subgrade. Due to load limits, operation of the paver on the existing pavement was officially ruled out. The only method left for the contractor was to employ his paver as a central mixing plant, mounting it upon a wooden platform so as to raise the discharge end to a height sufficient to deliver into the bodies of the truck-mounted agitators. With this set-up, the economies of using bulk cement could be realized and the size of the batch going through the paver could be increased 10 per cent or to a volume of 29.7 cu.ft.



FINISHING MACHINE follows on heels of lateral spreader fed by side-discharge from truck-mounted transport agitator.

To carry the concrete from the paver to the forms a fleet of three 1½-cu.yd. transport mixers, manufactured by the Concrete Transport Mixer Co., of St. Louis, and mounted on Dodge trucks, was sufficient to keep the paving crew busy. Rated at 1½-cu.yd. capacity when used as transport mixers, these machines actually carried 2.2 cu.yd. of concrete when employed as agitators, as was the case on this job. The concrete, agitated in transit by two revolving helical blades, was hauled a maximum of 1,000 ft. in each direction from the paver. Batches were discharged by tilting the agitator drum sideways, as illustrated. The side-discharge feature was advantageous, allowing the truck driver to pull alongside of and dump into a 10-ft. auger-type spreader trough. Specifications called for a concrete of from 0 to 2 in. slump, with a cement factor of 1.4 to 1.5 bbl. of cement per cubic yard. A strike-off on the spreader left the concrete surface 2 in. below finished grade to allow for placing wire-mesh reinforcement, which was topped off with additional concrete just ahead of the finishing machine.

Working an 8-hr. day and a 5-day week, the average progress for the job was 160.6 lin.ft. of 10-ft. pavement per hour. The best single day's run was 1,731 lin.ft.

Paving operations for the C. H. Atkinson Paving Co., of Chillicothe, Mo., were directed by Murray Wendell, general superintendent, and Winslow Tilford, job superintendent. For the Missouri Highway Department, P. A. McLeod was project engineer and Earl Olsen, inspector.

Crawler-Cranes Start Job for Deck Travelers

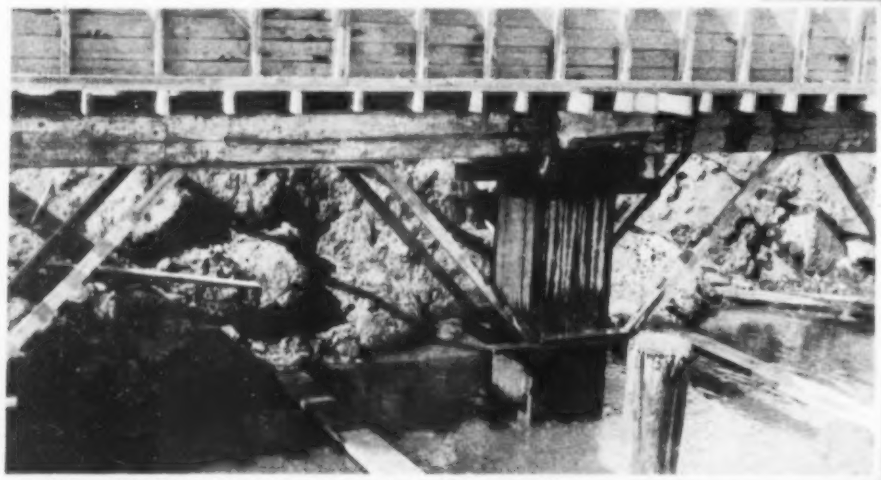
WORKING UNDER AN OVERHEAD POWER LINE. crawler cranes on the ground set the first two plate-girder spans of an eleven-span girder and truss bridge over the LaCrosse River on the LaCrosse-West Salem Road (U. S. 16), built by the Worden Allen Co., Milwaukee, Wis., under a $153,000 contract with the Wisconsin State Highway Commission. After the crawler cranes had completed erection of the first two spans, a large steel stiffleg derrick sitting on the ground erected the third span and assembled a smaller traveling derrick on this span. Following erection of the fourth span, the smaller traveling rig on the deck picked up the larger erection derrick and set it on the completed steelwork. The two travelers then worked ahead to the far abutment on the north side of the river.

How They Did It

CONSTRUCTION DETAILS For Superintendents and Foremen

IRIDESCENT STUCCO FINISH for buildings of 1939 Golden Gate International Exposition in San Francisco is furnished by application of vermiculite, an alteration product of mica which is "exploded" by heat and is commonly used as a loose-fill insulating material. Effect produced is that of a textured surface that sparkles under sunlight or floodlighting. Material is laid over fresh cement stucco and troweled in.

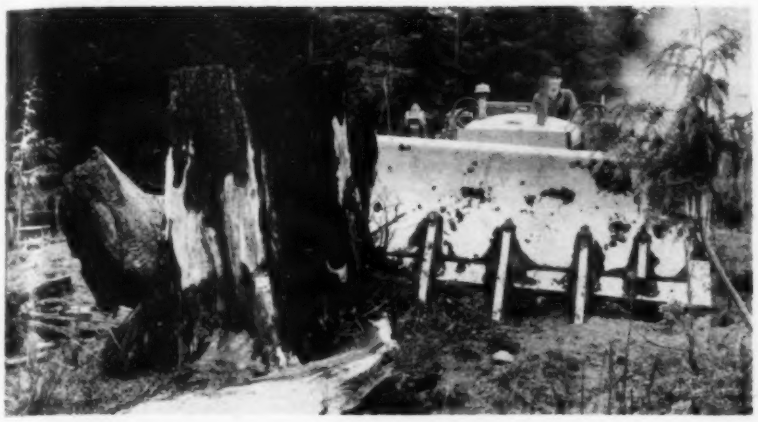
DOWEL BARS VIBRATED into place on concrete pavement built for Oregon State Highway Department. Lever on left end of bar holder releases dowel bars after concrete has been placed and vibrated. Method leaves whole assembly in perfect alignment. Note how force of vibrator throws concrete from edges of holder.



FORM SUPPORT for concrete bent substructure caps is accomplished by placing two 6x8-in. oak yokes, or collars, around columns and depending entirely upon friction of timbers pulled up to opposite faces by bolts along other faces. Knee-braces shown are supported by similar collars and are used only to reduce deflection of forms. Method is used by many contractors doing bridge work for Missouri Highway Department. — Photo from D. C. WOLFE, of Sverdrup & Parcel, consulting engineers, St. Louis, Mo.

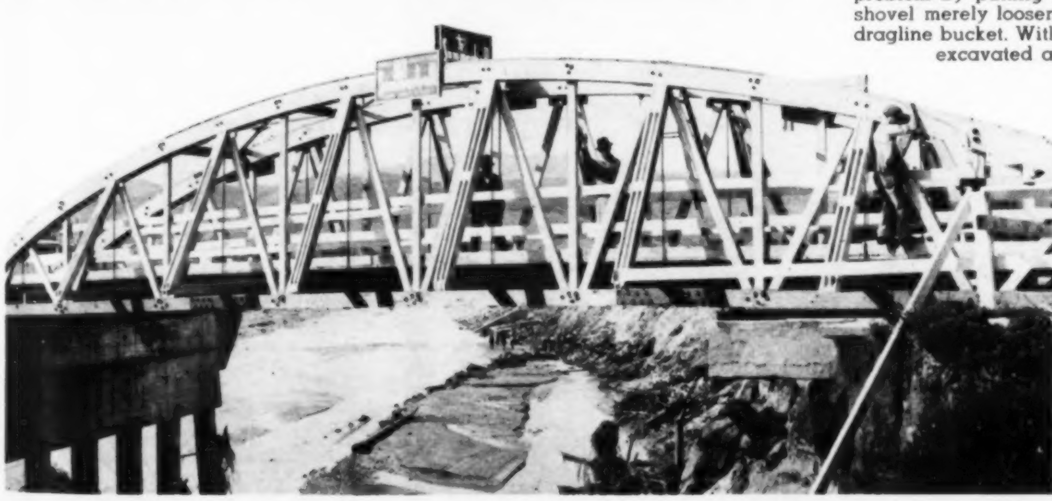
CULVERT HEADWALL on Blue Ridge Parkway utilizes native stone laid up in crescent shape, with concave face toward ditch line.

CONCRETE DELIVERY to Tifft St. viaduct in Buffalo, N. Y., was handled by John W. Cowper Co., local contractor, with long-boom crane and bottom-dump bucket served by fleet of 14 Blaw-Knox truck-mixers mounted on 4- to 6-ton, six-cylinder International motor trucks with double-reduction herringbone gear drives. Truck mixers were operated by Concrete Delivery Co., of Buffalo, for the Buffalo Slag Co.



FOR CLEARING LAND (above and below) in the State of Washington, H. H. Balch, contractor, of Port Angeles, used outfit consisting of an Allis-Chalmers tractor equipped fore and aft, respectively, with an Isaacson trac-dozer and a Carco winch. Trac-dozer blade has four special teeth to uproot tree stumps, which are pulled out by cable from winch.

TEAMWORK BY TWO EXCAVATORS, one equipped as a shovel and the other as a dragline, enabled Walraven Bros., excavating contractors, of Bay City, Mich., to make a profit in digging a pit 14 ft. deep, 38 ft. long and 28 ft. wide for an underground gasoline storage tank for the Star Oil Co. The heavy blue clay was too tough to be handled by a dragline excavator alone and the job was too small to warrant the building of a truck ramp. The contractors solved the problem by putting two Bay City $\frac{1}{2}$-yd. excavators on the job. The shovel merely loosened the clay and piled it up for removal by the dragline bucket. With this method of double handling 550 cu.yd. were excavated and removed to complete the pit in 8 hr.



EMERGENCY BRIDGE of 90-ft. span, erected by Summerbell Roof Structures for Warner Bros. Studios, provides first crossing of Los Angeles River following recent California floods in San Fernando Valley region. Wood trusses of this type are commonly used by motion-picture studios to support roofs of sound stages. Bridge trusses illustrated herewith were assembled and erected in 7 hr.

WANTED — Photos of Details

The Editor of Construction Methods wants photographs or sketches illustrating interesting DETAILS of method or equipment and will pay for those he finds acceptable for publication.

Hasn't your job produced some DETAIL that might be illustrated on this page? Send along a picture of it; we'll return it promptly if we can't use it.

TAR PAPER (right), is unrolled on subgrade of concrete pavement between Sherman and Springfield, Ill., to conserve moisture. Impervious membrane prevents absorption by subgrade earth of water in concrete mix needed for proper curing. — Photo from C. M. HATHAWAY, engineer of construction, Illinois Division of Highways.

WELDED SCRAP

Produces Mast and Boom for Derrick

Fig. 2 . . . **LOWER HALF OF DERRICK BASE** fabricated from scrap materials by electric arc welding.

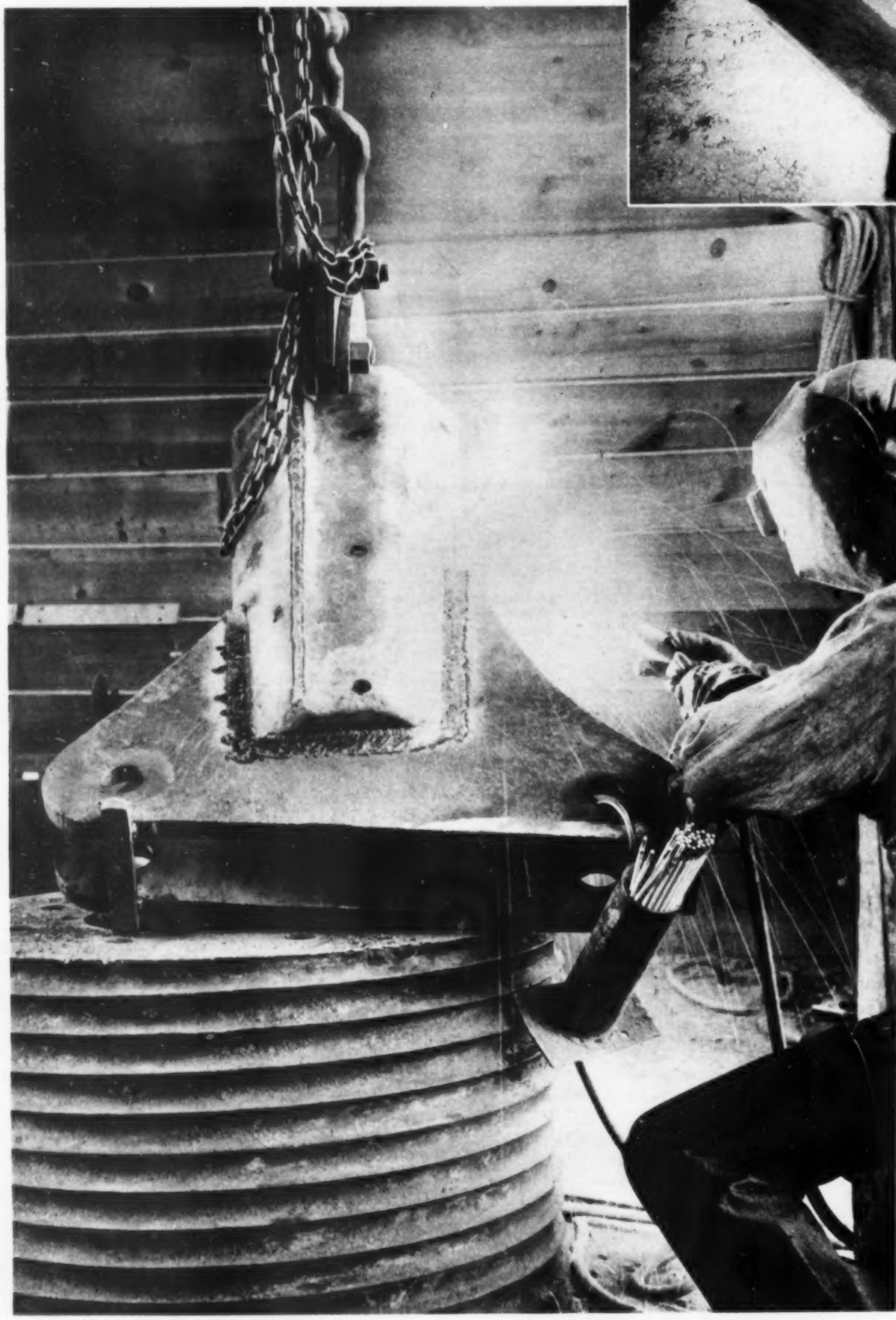


Fig. 1 . . . **FABRICATING** crown boom for derrick by electric arc welding, using parts reclaimed from scrap.

RECENTLY the W. E. Callahan Construction Co., of Dallas, Tex., on the All-American Canal project in California, had the opportunity to purchase a pair of aerial poles that were at one time used by the U. S. Signal Corps. These were cut down to 55 and 45 ft. lengths for the mast and boom of a derrick needed to replace an old piece of equipment. None of the metal parts of the old derrick was of the proper size to fit the new poles. Using odds and ends of plate from scrap, the shop foreman and chief welder designed and fabricated new parts. The accompanying photos show some of the work.

In Fig. 1 a workman is welding the boom crown, designed hexagonal shape to preserve the strength of the boom end. The pole was slotted on the end to take a sheave that was mounted inside the boom crown for the hoist or load line. Length overall, 37 in. inside diameter, taper from 12½ to 10 in.; made of ⅜- and 1-in. plate.

The boom nest was constructed of ⅜-in. plate (the hinge straps are 1 in.) and reinforced at the top with a ring. It has an overall length of 30 in. The socket is 20 in. deep and has an inside diameter that tapers from 15½ to 13 in. The 45-ft. boom rests in this socket where it can be moved up and down in vertical motion.

Fig. 2 shows the lower half of the derrick base or turntable. This piece is made of 1-in. plate, well reinforced. The two sheaves are for the hoist and boom lines. Size of plate, 40x36 in.

The welding was done with shielded arc equipment supplied by The Lincoln Electric Co., Cleveland, Ohio.

PONTOONS *Help Sinking of 60-In. Submarine Cast-Iron Pipe Sewer Lines*

WITH THE AID of floating equipment, divers and cylindrical pontoons, three lines of 60-in. cast-iron pipe, each 865 ft. long, were laid in a dredged trench across the Mississippi River between Minneapolis and St. Paul to form a connecting link in the Twin Cities sewerage system. In general, the method followed was to joint four 12-ft. lengths of pipe into 48-ft. sections on barges, float them into place with pontoons and sink them to a depth of 26 ft. from a derrick barge.

The floating equipment consisted of one 10-ton, 3-drum derrick barge with 90-ft. boom and three ordinary barges (each 100 ft. long), two of which were lashed side by side with 12x12-in. timbers to form a well, 9 ft. wide, spanned by a heavy-duty A-frame, with 17-ft. clearance, capable of handling a 40-ton load. These two barges were used for loading pipe sections under pontoons, while the third barge, equipped with a narrow-gage track, provided an area for assembling the pipe sections.

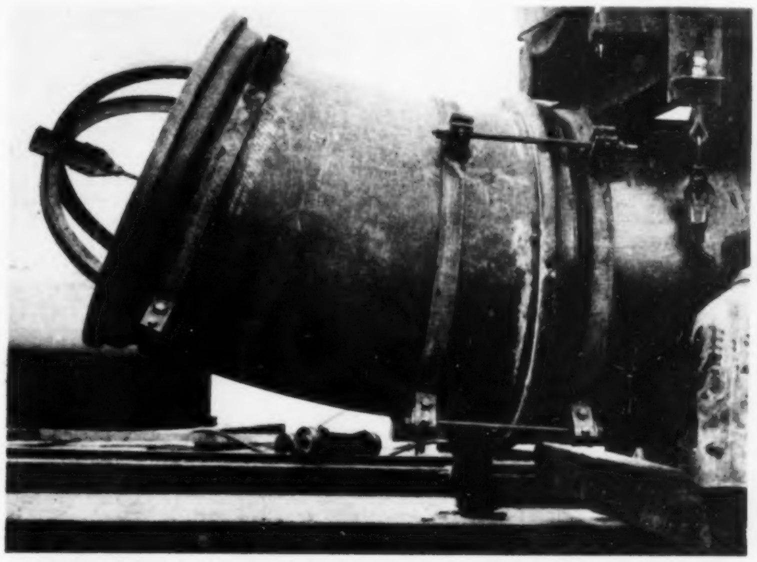
On the assembly barge the first step in the process was the leading of the bells of the modified Thacher joints of the pipe forming the 48-ft.-long sections. The three joints of each section were harnessed with two 4x1-in. circular bands having protruding ears, held in place by two $1\frac{1}{2}$-in. lock bolts, each 33 in. long. The joints were loaded and calked with an air hammer.

A jointed 48-ft. section of pipe weighing 47,500 lb. then was pulled from the assembly barge on to timbers placed over the well between the two other barges. A pontoon consisting of three 6-ft. 2-in. diameter cylindrical tanks, one main tank 33 ft. 9 in. long and two auxiliaries, each 6 ft. long, equipped with flood and vent valves, was lowered on to the pipe section and securely lashed to it with cables. Then a collapsible pipe guide, to facilitate placing the bell-leaded joint over the spigot of the adjoining section under water, was drawn through the pipe until its nose extended 2 to 3 ft. beyond the bell end, and expanded by means of turnbuckles, to a snug fit against the inner wall of the pipe. A hook rigged with a light cable released the guide after the underwater union was made later by a diver.

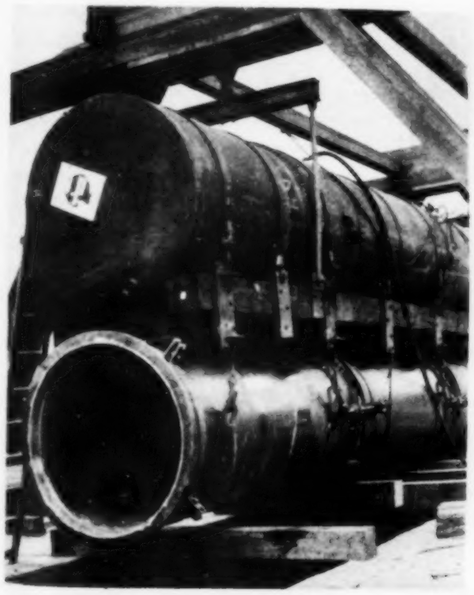
Photos, Cast Iron Pipe Research Assoc.

ASSEMBLED SECTION OF PIPE, 48 ft. long, is ready to be pulled under A-frame from which pontoon is suspended for attachment to top of pipe.

PELICAN HOOK allows diver to detach pontoon from pipe when in place on river bottom.



GUIDE protrudes from end of pipe to aid underwater jointing with adjacent section. Also shown is detail of harness and hook bolts at joint between sections of pipe.



PONTOON RAFT (left) is attached to top of 48-ft. pipe section by pelican hooks which are detached by divers when pipe is sunk to place.

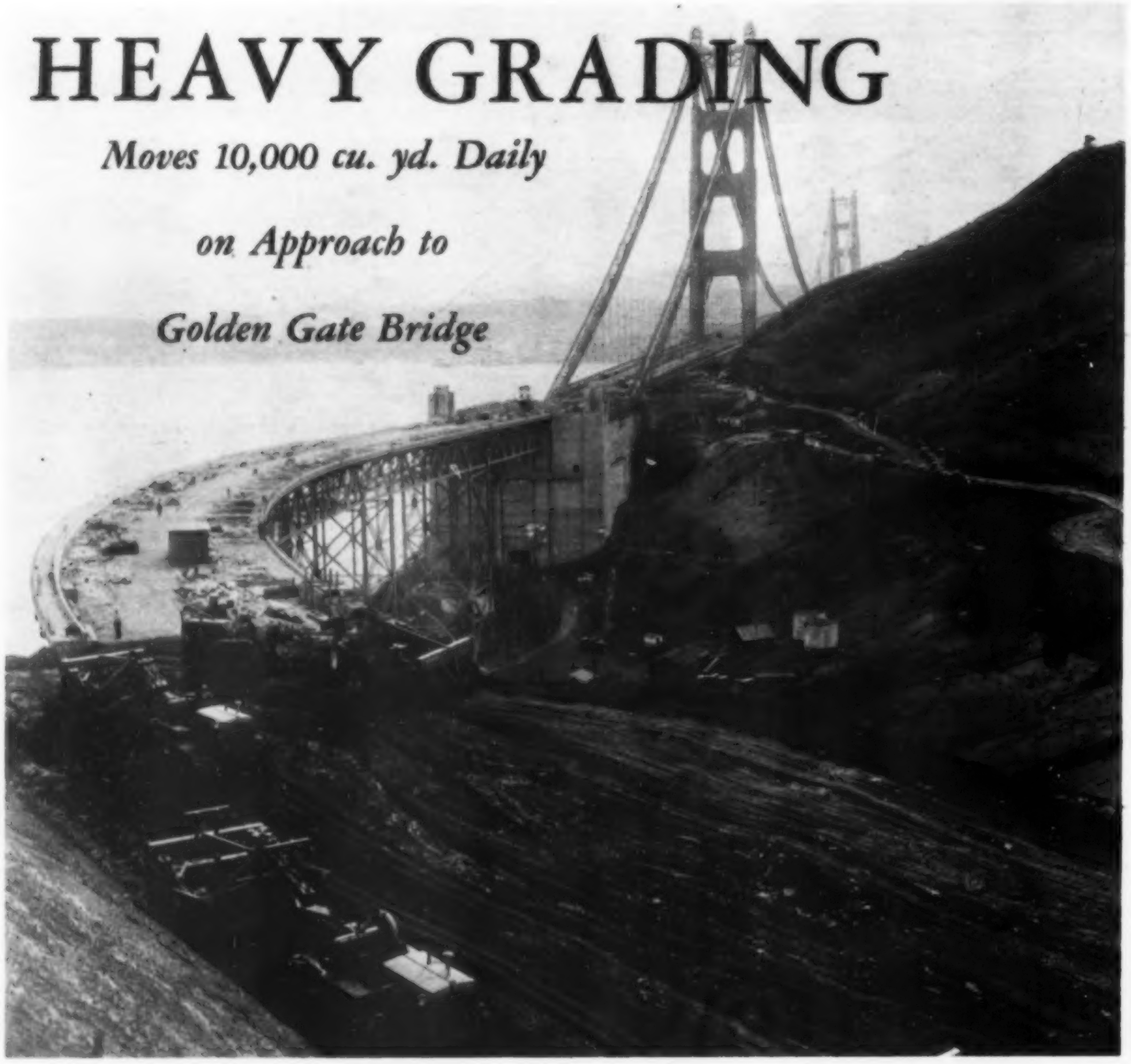
DERRICK BARGE, with 90-ft. boom, guides pontoon-supported pipe section to place for sinking. Note vertical tell-tale poles at each end of pontoon to indicate depth of submergence.

The pontoon-supported pipe section was then lowered by the A-frame rig into the well between the two barges and towed to position for sinking. Vents were opened to flood the auxiliary tanks and after the load had settled divers directed the final movement to exact line and grade for entering the joint and drawing up the lock bolts in the ears of the harness around the pipe. The main pontoon tank was then flooded, settling down on the pipe and loosening the load cables. Divers knocked off the shackles on pelican hooks, which released the pontoon, allowing it to float to the surface of the river. After divers, with air hammers, had calked the submerged joints between pipe sections, crushed stone ballast was placed around the pipe up to the spring line and the line was further weighted down by precast concrete block saddles in the form of quarter circles 4 ft. long and 12 in. thick, each weighing 6,500 lb. Above these anchor blocks additional stone ballast was placed to a depth of from 1 to 2 ft.

The work was done as a PWA project with Frank E. Lupe acting as resident engineer inspector.

HEAVY GRADING

Moves 10,000 cu. yd. Daily on Approach to Golden Gate Bridge



CARRYALL SCRAPERS of 12-14-cu. yd. capacity, hauled by diesel tractors, move earth at connection of U. S. Highway No. 1 with Golden Gate bridge, at Waldo.

COSTING nearly $2,000,000, or averaging about $550,000 per mile, and constituting one of the heaviest per-mile construction jobs ever undertaken in California, the Macco Construction Co., of Clearwater, Calif., and T. E. Connolly, Inc., of San Francisco, under the direction of the California Division of Highways, completed last year the 3.6-mi. section serving as a connection between the north abutment of the Golden Gate bridge and U. S. Highway 101 at Waldo. The new road passes along the rugged hillsides rising behind the City of Sausalito, with a 1,000-ft. tunnel through the long ridge at the southerly limits of the city.

Owing to the rough topography on the Marin County hillsides, construction of the roadbed required exceptionally heavy grading, and the removal of more than 2,500,000 cu.yd. of roadway excavation, including 750,000 cu.yd. of slides, and called for careful selection and direction of earth-moving equipment on the part of the grading contractor, the Macco Construction Co. Accordingly, B. F. Wells, superintendent, mobilized a fleet of earth-moving units comprising LeTourneau carryall scrapers of 12 and 14-cu.yd. capacity, Caterpillar diesel tractors, LeTourneau bulldozers, two- and three-section LeTourneau sheepsfoot rollers, 5- and 8-yd. Fageol, International, and Mack end-dump trucks, 1½- and 2½-yd. Northwest diesel and Lorain gas shovels, scarifiers, and 10-ton rollers. This equipment moved an average of 10,000 cu.yd. a day from 18 cuts into 20 fills, where the material was graded and tamped in thin layers.

While this work was going on, the tunnel contractor, T. E. Connolly, Inc., under a separate contract, was constructing the ¼-mi. tunnel and portals. The grading-surfacing and tunnel contracts amounted to approximately $1,200,000 and $620,000, respectively.

Except in the tunnel, the road has a 42-ft., four-lane width of plant-mix asphalt surfacing of the medium curing type, with a fairly flat crown of 2½ in. and 2-ft. rock shoulders. Maximum grade is 6 per cent. Crusher-run base, 6 in. thick on a 46-ft. width subgrade, supports the 3-in. thickness of surfacing.

The 3.6 mi. of roadway grading contract involved cuts and fills up to 200 ft. vertical height. In most of the cuts about 50 per cent of the material was removed by carryall scrapers and the remainder by power shovels loading into trucks, though in some instances entire cuts were excavated exclusively by one or the other type of equipment.

Embankments were constructed with 1:1½ slopes. Sidehill fills too deep and narrow to permit construction roadways were built by end-dumping from above, compacting the layers below and gradually bringing up the fill level to grade. The sides of the embankments were brought up first, leaving the center lower than the shoulders. Fills constructed of earth or material composed of chert or small particles of rock, or containing by volume less than 25 per cent of rock larger than 6 in., were brought up in compacted layers not exceeding 8 in. in thickness. Fill material containing, by volume, 25 per cent or more of rock too large to be compacted in layers 8 in. thick, was placed in layers about the maximum size of the rock, but never exceeding 2 ft. While the coarse material was being deposited, sufficient fines and earth were added to fill the voids and thus assure a dense, solid embankment. Each layer was compacted both by routing the loaded earth-moving units over the entire width of the fill, and by rolling.

The relative compaction of the earthy material comprising each layer of embankment averaged between 90 and 95 per cent of the maximum compaction obtainable under laboratory conditions, where a 2,000 lb. per square inch consolidation load is applied. Embankment material that did not contain sufficient moisture to

HAUL ROAD to fill for new road carries earth-moving equipment at three levels.

CUTS AND FILLS on 3.6-mi. route required movement of 2,500,000 cu.yd. of material, including 750,000 cu.yd. of slides.

reach the required 90 per cent relative compaction was sprinkled with water, while that with an excess of moisture was allowed to dry to the proper consistency before being compacted. Tamping of the spread material was done either by sheepsfoot rollers hauled by diesel tractors or three-wheel rollers, with at least one unit being provided for every 100 cu.yd. of embankment material placed per hour.

Preliminary investigation of the proposed fill sections in the first mile of the project disclosed poor foundations. This condition was overcome by first stripping and trench-excavating unsuitable material, consisting chiefly of saturated clay and decomposed serpentine (which existed to depths of as much as 40 ft. under certain major embankments), and then refilling with rock placed in layers from 5 to 15 ft. thick. To prevent any outward movement or slippage, rock dikes were constructed in deep trenches at the toe of the fill, varying in width from 20 to 40 ft. and extending a minimum of 10 ft. above the normal toe of the fill slope.

Before placing the plant-mix surfacing, the subgrade was plowed or scarified to a depth of about 6 in. below the final grade, and the material brought to a finely divided condition by harrowing, breaking clods and dry rolling. All boulders, hard ribs, or solid rock encountered were removed. Next, material was graded to proper height by a road grader, the surplus earth being moved outside the subgrade width to be used for shoulders. Thorough and uniform watering and harrowing to mix the wet material with the dry beneath followed. Final rolling was done with a 10-ton roller.

The crusher-run base was uniformly spread on the finished subgrade by spreader boxes in two layers. On side roads, where the required thickness was less than 4 in., it was placed in one layer. One 10-ton roller was employed for each 400 tons of crusher-run base laid per 8-hr. day. Upon this base a prime coat of light road oil was placed and allowed to penetrate before depositing an armor coat of ¾-in. rock, oiled with 90-95 road oil and sealed with fine screenings The road was then opened to traffic with the opening of the Golden Gate bridge on May 28, 1937.

After a week of this initial heavy traffic, the 3-in. plant-mix surfacing, medium curing type, was spread half-roadway width at a time by spreader boxes equipped with adjustable strike-off leveling blades. Specifications of the mineral aggregates used in the surfacing required 100 per cent to pass 1-in. circular screen openings, being uniformly graded to from 6 to 11 per cent passing a 200-mesh sieve. The medium curing liquid asphalt added to the mineral aggregates consisted of Grade E asphalt, with an upper limit of about 120 deg. penetration, fluxed with a kerosene solvent. Mixing of the solid and liquid ingredients was done in a 1-ton (revised belt feed) Madsen plant at Hutchinson's quarry, whence the finished product was trucked to the project. About 51,000 tons of crushed rock and 1,120 tons of liquid asphalts were used in the construction of the plant-mix surfacing.

Tunnel Contract — The contract

BITUMINOUS SURFACING for roadway was mixed at this 1-ton Madsen plant.

CRUSHER RUN BASE to carry bituminous surfacing is placed by spreader box on rear end of truck.

PORTABLE GREASING PLANT, carried on Dodge truck, contains small air compressor, grease guns, lamps for night work and oils and greases for lubricating excavating equipment.

the full length of the tunnel on both sides in the wall drifts before general stoping excavation between wall and crown drifts was started.

The ringing out or stoping excavation was then carried just ahead of the setting of 8-in. steel "H" beams curved on a 27-ft. general radius to closely fit the exterior face of the excavation. These "H" beams were in sets of 5 sections of equal length bolted together and set on the concrete side wall footings. They were spaced at 2-ft. centers for 100 ft. at each end, and 3 ft. 6 in. for the interior 800 ft., and all were subsequently incased solidly in the concrete lining.

The concrete ring lining was placed by means of a concrete pump set at

TUNNEL, 1,000 ft. long, carries road through hill at Sausalito. At portal of bore 29 ft. high, bituminous surfacing mix is deposited on 42-ft. roadway by one of fleet of five GMC trucks making 7-mi. haul from mixing plant.

STEEL FORM JUMBO (right) is used for lining tunnel with concrete, pumped into place. Excavation of tunnel core followed concrete lining.

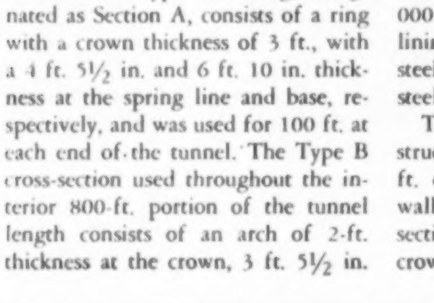
awarded to T. E. Connolly, Inc., provided for the construction of a tunnel 1,000 ft. long, with reinforced lining. The design calls for a roadway 42 ft. wide between curbs, with a $3\frac{1}{2}$-ft. sidewalk on one side. Total height on the center line of the tunnel is 28 ft. 9 in., while the height from the spring line is 23 ft. 6 in. There are two types of tunnel lining. The heavier type of lining, designated as Section A, consists of a ring with a crown thickness of 3 ft., with a 4 ft. $5\frac{1}{2}$ in. and 6 ft. 10 in. thickness at the spring line and base, respectively, and was used for 100 ft. at each end of the tunnel. The Type B cross-section used throughout the interior 800-ft. portion of the tunnel length consists of an arch of 2-ft. thickness at the crown, 3 ft. $5\frac{1}{2}$ in. at the spring line, and 5 ft. 10 in. at the base.

Construction of the tunnel involved 111,000 yd. of roadway excavation with about 1,400,000 station-yards of overhaul, 4,000 yd. of structure excavation, and 51,000 yd. of tunnel excavation. About 1,800 yd. and 1,225 yd. of concrete were used, respectively, in the portals and the pavement curbs and sidewalks, apart from 11,000 cu.yd. of concrete in the tunnel lining, 314,000 lb. of bar reinforcing steel, and 1,000,000 lb. of structural steel.

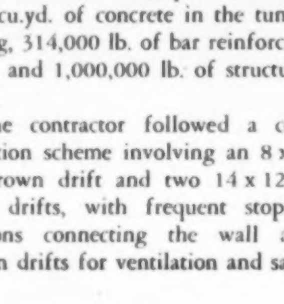
The contractor followed a construction scheme involving an 8 x 8-ft. crown drift and two 14 x 12-ft. wall drifts, with frequent stoping sections connecting the wall and crown drifts for ventilation and safety measures. The crown drift required timbering for less than 600 ft. of its length, but as a safety precaution both wall drifts were timbered throughout, although there was no evidence of weight upon the timbering. Concrete side-wall footings were poured for

the north portal, which was fed by skips delivering the mixed concrete via a trestle incline from the concrete mixers several hundred feet down the mountain side. Traveling jumbo, or "inside" forms were used for this concreting operation. Excavation of the core followed the concrete lining, with paving and finishing details succeeding the core removal. This sequence of operations and methods of construction was predicated upon the basic design provided by the Division of Highways.

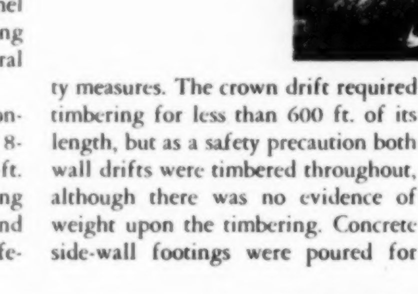
The Waldo road project was designed and executed under the general supervision of the California Division of Highways, John H. Skeggs, district engineer, San Francisco, and E. G. Poss, district construction engineer, in charge of construction. H. S. Payson was resident engineer on the roadway grading contract. B. F. Wells, general superintendent, directed operations for the Macco Construction Co. T. E. Ferneau was resident engineer on the tunnel contract, and Fred Brunskoll and Earl Walsh were superintendents for T. E. Connolly, Inc., in charge of tunneling and concreting operations, respectively.



RESIDENT ENGINEER on tunnel project, T. E. FERNEAU (center) confers with GEORGE A. GREENE (left), assistant resident engineer, and FRED BRUNSKOLL, superintendent for T. E. Connolly, Inc., contractor.



RESIDENT ENGINEER on road grading contract is H. S. PAYSON, of California Division of Highways.

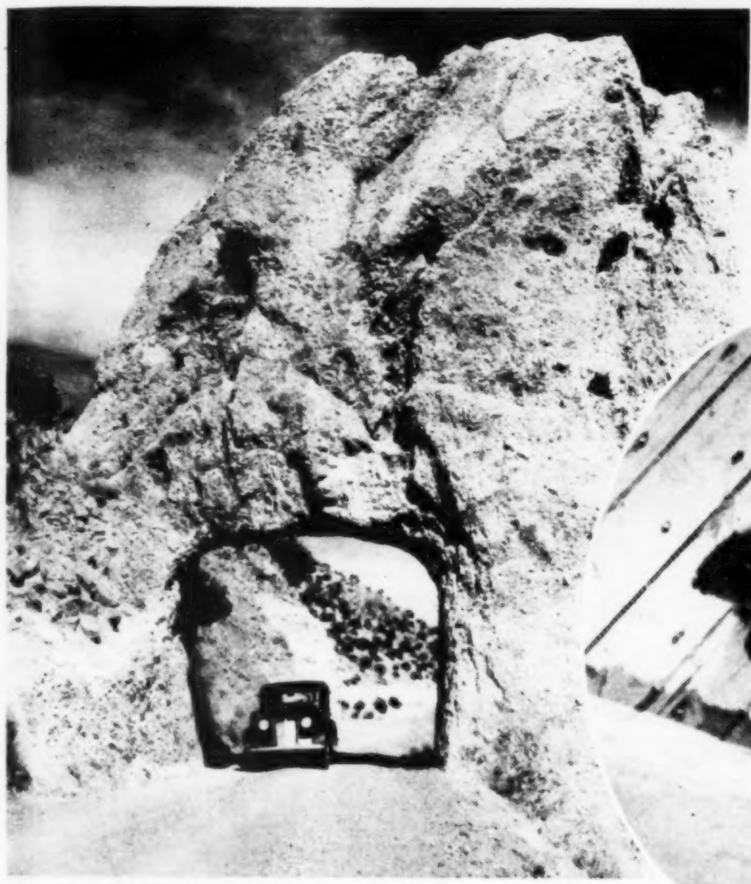


GENERAL SUPERINTENDENT for Macco Construction Co. is B. F. WELLS (left) who looks over job with E. CARLSTAD, assistant resident engineer.

JOB ODDITIES

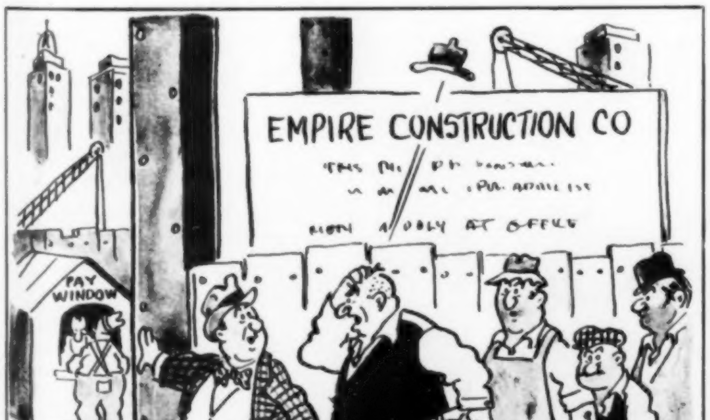
A MONTHLY PAGE OF

Unusual Features of Construction



MIDGET TUNNEL. What is claimed to be one of the world's shortest tunnels is the Mule Creek bore, 10 ft. long, near Clifton, Ariz., on one of the routes of the Arizona Highway Department.

DAM INSPECTION BY AN EXPERT! Nature's original dam builder, the beaver, **(above and left)** pays a visit to the Grand Coulee project under construction on Columbia River in Washington and makes a critical appraisal of the work done for the U. S. Bureau of Reclamation by the Mason-Walsh-Atkinson-Kier Co. and Consolidated Builders, Inc.



"What made ya think I was waitin' in line for a pay check? I'm waitin' for my girl!"

BOLT BIRTHPLACE. Front wall and part of roof of America's first bolt factory, historic old building erected with hand forged nails in 1840 for manufacture of bolts and nuts, has been reassembled and set up in the lobby of the office of Clark Bros. Bolt Co., at Milldale, Conn., to illustrate humble cradle from which grew the company's present large, modern plant.

Present and Accounted For ~

A Page of

PERSONALITIES

Bridgeport Post Photo

WILLIAM J. COX, until recently assistant professor of engineering mechanics at Yale University, New Haven, Conn., has been appointed state highway commissioner of Connecticut, succeeding John A. MacDonald. His previous experience includes surveys of Kentucky coal fields and service with Charles T. Main, consulting engineer, of Boston, on building and paving work, and with the J.A.P. Chrisfield Contracting Co. on dam and power plant projects in Connecticut. He is a former traffic engineer for the National Bureau of Casualty and Surety Underwriters of New York City. He was a faculty member at Yale since the year 1927.

RALPH LOWRY, who, since 1935, has served the U. S. Bureau of Reclamation as director and construction engineer of the Boulder Canyon project (Boulder dam) has been transferred to the Bureau's Central Valley project in California to become construction engineer of Shasta dam, for which bids amounting to about $36,000,000 were received June 1. Shasta dam, 560 ft. high, will contain 5,610,000 cu.yd. of concrete, second only to Grand Coulee dam's 11,250,000 cu.yd. and exceeding Boulder dam's 4,325,000 cu.yd.

ALEX HANCOCK has been re-elected to serve his sixth consecutive term as president of the Alabama Road Builders' Association, an affiliate of the American Road Builders' Association. Mr. Hancock is president of the Hancock Co., of Mobile, Ala., specializing in highway and heavy construction.

THEODORE B. PARKER (right), until recently chief construction engineer, has been appointed chief engineer of the Tennessee Valley Authority, and Carl A. Bock becomes chief consulting engineer after service with the TVA since 1933 as assistant chief engineer. The position of chief engineer, originally held by Dr. Arthur E. Morgan, has been vacant since July, 1937, following an administrative reorganization of the Authority. Mr. Parker, a graduate of Massachusetts Institute of Technology, has served with the Utah Power & Light Co., the Electric Bond & Share Co., the U. S. Army, Stone & Webster Engineering Corp., and with PWA in Massachusetts. He saw duty with the A.E.F. in France during the World War and is now a lieutenant colonel in the Engineer Reserve Corps.

BERT CAREY, concrete contractor of Forest Park, Ill., who served as chairman of the organizing committee, has been elected president of the newly formed American Concrete Contractors' Association. Among aims of the new association are "quality and good workmanship on concrete construction."

E. M. TURNER (third from left) is the newly appointed state highway engineer of Tennessee, succeeding O. F. Goetz. Highway department and contractor personnel in photograph above are, left to right: JACK PATTON, resident engineer; JOHN OMAN, contractor; State Highway Engineer TURNER; O. E. MARTIN, engineer of surveys and design; J. H. COLES, division maintenance engineer; H. D. LONG, construction engineer.

DO BUILDINGS COST TOO MUCH?

By ARTHUR F. COMSTOCK

Formerly Chief Estimator, James Stewart & Co., Inc., Contractors, New York City

DISCUSSION evoked by my article "Do Buildings Cost too Much?" (see *Construction Methods and Equipment* for April and May) brought forth a number of well-considered viewpoints indicating that the subject is one of general interest in the industry and deserving of further comment.

Union Labor

Mr. Sollitt's observation that union labor's interests are not necessarily incompatible with those of the contractor is, it seems to me, a sound one. In applying this principle, however, my understanding is that both can prosper only by keeping the building industry attuned to general economic conditions, and that when such balance is maintained there cannot be any vast difference between costs of building with union labor or otherwise. I judge that Mr. Sollitt entertains somewhat the same opinion.

Mr. Eken's views on the Voluntary Codes of Fair Competition were brief, but pointed. Anyone seeking light on what can happen under these codes could profitably read the current New York newspapers, especially The Sun, which have been publishing testimony recently taken in a lawsuit brought by The National Electrical Manufacturers' Association against Local No. 3 of the Electrical Union.

Mr. Greensfelder's statement that "we need the truth" is, of course, fundamental, and with it most of us can heartily agree. Competent discussion of our problems is unquestionably one of our present deficiencies.

Working Hours

Lack of uniformity among various building trades in the number of working hours per day, as brought out by Mr. Luce, is a current difficulty in New York which needs correction. This irregularity was started by the trade which has been the bell-cow of the codes, and was begun without assent of the other trades.

Increased cost due to the "warming-up" period in the morning and the "easing-off" period at the end of the day, calculated on a 6-hr. day as against an 8-hr. day, is a moot question. Several New York employers in different trades have found that increased efficiency per hour offsets any theoretical loss due to the cause mentioned. However, diverse factors affect production, and Mr. Luce's extensive experience, as well as Mr. Ferguson's, seem to be at variance with my conclusions.

Wage Rates

Both Mr. Cowper and Mr. Griffiths emphasize the point that while building wages are high, considered merely on an hourly basis, annual wages are relatively low because of lost time. This was conceded in my article and I believe is generally accepted. Nevertheless, it seems to me axiomatic that labor can obtain a larger annual income only through larger volume of building and that larger volume at this time is definitely retarded by wage scales approximating in New York 16 per cent above the 1926 level.

Mr. Cowper's timely reference to taxes reminds me of something I neglected to show in regard to increased material costs between 1934 and 1938. In New York City a 2-per cent sales tax was levied in December, 1934, and is still in effect, applying to materials. It adds to the building cost 1.2 per cent. Social Security and Unemployment taxes, federal and state, for the year 1937 aggregate 3.2 per cent, making a total increase in such taxes of 4.4 per cent. Deducting this from 11.4 per cent increase in materials for a typical office building (See *Construction Methods and Equipment*, April, 1938), and deducting a further 1 per cent for workmen's compensation, public liability and other insurance on the 19.6-per cent increase in labor, we have a net increase in materials proper, when disassociated from taxes and insurance, of only 6 per cent. If one had the time to trace this 6 per cent back through the various trades to the mines or plants where these materials originate, the major part of it would likely be found in increased shop wages and taxes. If there has been any disposition to jack up prices so as to take advantage of new taxes, the guilt is not upon the manufacturers, as so often charged by politicians and labor leaders.

Decreased carrying charges resulting from the drop in interest rates, as brought out by Mr. Hamilton, particularly as to F.H.A. mortgages, while a favorable factor to the extent of possibly 1.5 per cent, does not go far in offsetting an average increase of 14 per cent in labor and materials. In this connection it seems to me we should not be misled by the mirage of further government spending for construction. It cannot solve our problem and may prove in the long run a detriment, instead of a help. Basic improvement in construction activity can come only from industrial and general business revival and farm prosperity. We have already been overdosed with the nostrums of economic dope peddlers, whose power for good is small but whose power for harm is colossal.

Voluntary Codes

As to the "Voluntary Codes of Fair Competition," a title decidedly misleading in its implications, I quite agree with Mr. Siesel that they are likely to be of limited duration. The industry should halt their further expansion. If the codes are constructive, as their sponsors claim, they deserve success; but if they are destructive, as others believe, they deserve the oblivion which some of us understood the Supreme Court had already given them.

Cost-Plus Contracts

Morton C. Tuttle's discussion in last month's issue of my article "Do Buildings Cost Too Much?" strikes me as an extremely able exposition of the advantages claimed by proponents of the cost-plus system of awarding contracts. Most contractors would agree, I suppose, that "cost-plus is nice work if you can get it." Did anyone ever hear of a contractor who refused it? But, seriously, we are discussing methods or hopes of reducing costs, not of increasing them. And if we cannot keep depression wages below $2.00 an hour under competitive bidding who can prophesy the rates in good times under the cost-plus system?

Mr. Tuttle, in common with many other experienced builders, despairs of hope that our contractors' associations will resist wage increases until their last suit is threadbare. Well, it won't be long at present rates. It does seem strange that in discussing present wage rates with some association representatives and then with union leaders, we get pretty much the same answer, except that the former's is perhaps a little more polite.

It is difficult to understand Mr. Tuttle's analogy between mass production of, say, an automobile and erection of a building. The two processes, their inherent problems, the methods required — are quite dissimilar.

Nor is it easy to acquiesce in the thought that "architects seldom have access to cost information." This writer's experience has not led to such conclusion. Many architects plan and supervise as much annual construction as almost any contractor builds. Moreover, if the architect is in doubt about costs of a proposed structure, he usually consults one or more contractors. Strangely enough, even some of our ablest contractors have been able to predict ultimate costs in certain cases within reasonable bounds.

If "construction is not a coordinated industry," as Mr. Tuttle affirms, then his argument would seem to tend toward combining all elements from design to completion under a single agency.

I also disagree that it is conventional practice to exclude mechanical trades from the general contract. Such is not the practice of the United States Government, the largest awarding agency in this country; neither is it the practice of many of our largest architectural firms. Where mechanical trades are excluded as on municipal or state work, I also question that it is so done primarily for reasons of quality.

The suggestion that a builder cannot be trusted to represent the owner's interest, except under certain forms of contract, seems a novel argument. Can any contract be better than the conscience that signed it?

Mr. Tuttle's example of a contractor having been in business continuously for three generations and operating under a particular form of contract is certainly a deserved tribute to an organization loyal to splendid ideals. Such enduring success could only come from continuous fidelity to the best interests of the industry. And yet, there are other firms in our business which have existed for three generations, which have operated under various forms or all forms of contracts, and have still maintained a most enviable record for quality work. I suppose this all goes to prove that contractors are a hardy lot.

With reference to "shrewd buying," or what is sometimes called chiseling, we are no doubt speaking of a serious detriment which the depression has accelerated. However, my observation leads to the thought that it is somewhat prevalent under all forms of contract. Perhaps if subcontracts also were awarded on a cost-plus basis a cure might be ef-

30 days faster with LEHIGH EARLY STRENGTH CEMENT

Arnold Constable Company Department Store (150 ft. x 150 ft.), New Rochelle, New York

August 4, 1937—
Excavation started

August 14, 1937—
First concrete poured

August 15, 1937—First forms stripped for re-use

August 23, 1937—Last forms stripped and steel erection begun

November 25, 1937—Opened to the public—100 working days for entire operation

Architect:
Kenneth Franzheim, New York
General Contractor:
M. Bartnett & Sons, New Rochelle
Concrete Contractor:
Hernandez Contracting Co., Inc. Yonkers

To cash in on fall trade, the owners insisted upon quick building. By careful planning and the utilization of new, better, faster methods and materials, M. Bartnett & Sons, General Contractors of New Rochelle, turned the building over to the owners in record time. Only ten days after the excavation started Hernandez Contracting Co., Inc., the concrete sub-contractor, started pouring the concrete for footings and foundations. For speed, Lehigh Early Strength Cement was used—compared with normal portland cement, this was 30 days faster. Forms were stripped the day after pouring and used again for economy. Steel erectors were on the job only 10 days after the first concrete was poured. Lehigh Early Strength Cement reaches service strength in 24 to 48 hours—used under the same conditions the curing time for normal portland cement is 3 to 5 times slower. You can apply this speed to any kind of concrete work. Quick service concrete in key portions may expedite an entire operation like on this department store job. Its use often reduces costs. Shorter job duration means lower job overhead. Form costs are minimum because of quick re-use. In cold weather, heat protection costs are almost negligible. Use Lehigh Early Strength Cement wherever speed is vital or economies will result. Consult the Lehigh Service Department for specific data.

LEHIGH PORTLAND CEMENT COMPANY
Allentown, Pa. · Chicago, Ill. · Spokane, Wash.

fected. But is it not true that no product can be purchased at a price which no one will accept?

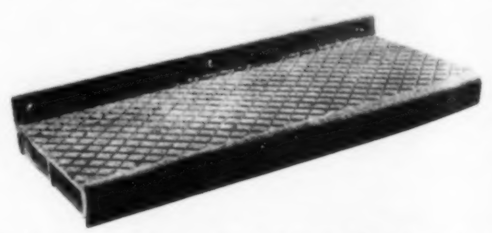
Regarding the general subject of the best type of contract, it seems to me that there is no one type best fitted for all conditions of our widely diversified industry. Alteration and renovation work, certain highly specialized industrial plants, public utility branches, unique engineering structures, highly monumental buildings or any project where the nature or scope of work cannot be fully pre-determined or estimated, is subject to special and varying forms of contract.

Lump-Sum Contracts

In conclusion, and for the purpose of a more comprehensive discussion, there follows a summary of the claims in favor of lump-sum contracts, still our most common form:

1. With a competent, experienced architect, the owner is fully protected as to advice on materials, their costs and desirability.
2. Since a general contractor sublets most of the work, changes in plans during the construction period must be handled for adjustment in the same way under either form of contract.
3. In either form of contract the approval of subcontractors rests with the owner, under advice of the architect, and the same sub-contractors would be largely employed under either form of contract and the same quality of materials and workmanship insisted upon.
4. A general contractor, operating on, say, a cost-plus-fee basis, with a guaranteed upset price, will incline toward establishing a quite safe upset price rather than a close cost figure.
5. In the event of over-run of the upset cost, for whatever reason, the architect or owner is likely to be blamed for the excess cost.
6. The cost-plus contract is more applicable to cases where plans, specifications and choice of materials are not completed at the time of entering a contract.
7. The cost-plus contract is favorable to the owner in a period of declining prices, but unfavorable when materials and labor are rising.
8. Workmen on the job, learning, as they usually do, that the work is not being done on a strictly lump-sum contract, do not perform as efficiently as they otherwise would. As was said of our cost-plus work during the World War, "Even the mules know it."
9. The lump-sum contract insures the lowest costs consistent with quality.

NON-SKID FLOORING AND STAIR TREADS are made of improved type of carborundum surfaced metal said to be highly resistant to rust and acid corrosion and unaffected in its non-slip properties by water, oil or other slippery liquid substances. Unique casting process assures wear and corrosion



resistant "nose" to stair treads as electric furnace abrasive grains applied in manufacture are carried entirely over nose and concentrated at this vital slipping point. Sluffing out and loss of abrasive grains, due to corrosion along nose said to be prevented by this method as no grinding is necessary to remove raw fins of metal on casting ridge. Non-slip Absco metal used extensively for stair treads, ramps, industrial floors, platforms, elevator door sills, swing-type door thresholds, trench covers, etc. Said to be valuable in preventing many industrial accidents.—**American Brake Shoe & Foundry Co., 230 Park Ave., New York City.**

DOUBLE DUTY

2-Wheel SCRAPER

PERFECT "team work" between the Bucyrus-Erie 2-Wheel Scraper and Bullgrader enables a single tractor, and a single operator, to handle a wide range of economical, high-speed dirt-moving. The Scraper is built to utilize every feature of the tractor's power and maneuverability. It digs effectively, loads easily, fills rapidly to high, heaping loads, and is hauled to the dump at fast tractor speed. The Scraper can dump its load at the rear for culvert work on a road job, or bulldoze it backward over a fill. Bucyrus-Erie 2-Wheel Scrapers are built in 2 sizes, 3½- and 6-yard, *struck-measure-rated.*

BULLGRADER

THE BULLGRADER front-end operates on a positive-acting dual hydraulic control system with the Scraper. The blade may be angled quickly to either side for smooth, accurate grading—or set straight across for bulldozing. The unit is balanced to convert tractor power into profitable pay-load performance in all types of material . . . It will pay you to investigate Bucyrus-Erie's complete line of modern tractor equipment, including Bullgraders, Bulldozers, 2-Wheel (hydraulic powered) Scrapers, and 4-Wheel (cable-operated) Scrapers.

BUCYRUS - ERIE

SOUTH MILWAUKEE, WISCONSIN, U. S. A.

CONSTRUCTION EQUIPMENT NEWS

Review of Construction Machinery and Materials for JULY, 1938

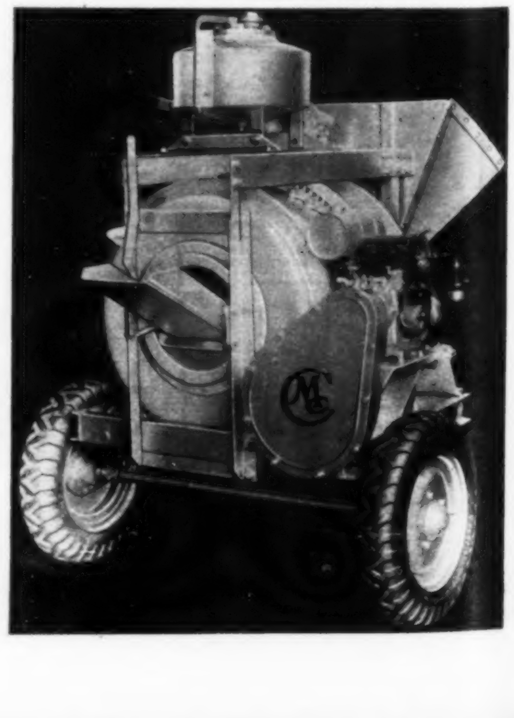
CONVERTIBLE ¾-YD. SHOVEL has swing speeds stepped up to increase number of digging cycles per minute and employs more power per pound of weight, preformed rolled steel construction providing strength safely to handle extra power. Lighter overall weight is said more closely to approach highway load limits, to make moving easier and less expensive and to reduce ground bearing pressure. Long boom and dipper sticks increase shovel working ranges. Oversize clutches and brakes make full dippers easy to handle at wide radii. Powered by 72-hp. gasoline or diesel power plant. Major shafts journalled in anti-friction bearings. Chain or cable types of shovel crowd optional. Pre-formed, rolled-steel boom and dipper sticks. Cast manganese alloy dipper front has integral tooth bases. Deck machinery balanced back of center line of rotation. Boom loads and swing strains absorbed by four hook rollers which ride on wide diameter roller path. 20-in.-wide, single driving lug, self-cleaning type crawler treads. — **The Byers Machine Co., Ravenna, Ohio.**

COMBINATION WHEELBARROW AND CONCRETE MIXER for small jobs where concrete is ordinarily mixed by hand mixes concrete thoroughly while it is being pushed a distance of 40 or 50 ft. Watertight drum is 21 in. deep, 17 in. in diameter at bottom and 13 in. diameter at opening. Equipped with four large curved paddles that mix concrete in few seconds. Frame and legs are of 1½-in. channel iron. Pipe hand holds. Wheel equipped with 12x3.50-in. four-ply pneumatic rubber tire. Nose iron extending beyond wheel allows drum to be dumped in any direction. Weight, 70 lb.—**Lansing Co., Lansing, Mich.**

SIX NEW CAB-OVER-ENGINE MODELS rated at from 12,000 to 23,000 lb. gross, have been added to Mack line of trucks. Of all-metal construction, cabs have been designed with eye to safety as well as comfort. Equipped with safety glass throughout and with such de luxe interior fittings as a domelight

and an indirectly lighted board fitted with clock-type instruments. Powered by six-cylinder engine developing respectively 75 hp. at 2,800 r.p.m.; 78 hp. at 2,800 r.p.m.; 85 hp. at 2,800 r.p.m.; (2 models) 90 hp. at 3,000 r.p.m.; 100 hp. at 2,800 r.p.m. Crankshafts of all models have seven bearings and are fully counterweighted on every throw. Drive is from dry, single plate clutch through four speed, selective, unit-with-engine transmission, five-speed transmission being available at extra cost. All rear-axles full floating. Internal type four-wheel footbrakes.—**Mack Trucks, Inc., 34th St., and 48th Ave., Long Island City, N. Y.**

NON-TILT END-DISCHARGE MIXER (3½S) is said to produce up to 40 cu.yd. per day because of its low front, high back, gated batch hopper, which eliminates mixing delays due to loading. Other features: — balloon pneumatic-tired wheels, Timken bearings, cantilever springs, disappearing tongue air-cooled engine, accurate vertical syphon measuring water tank (optional) proved double-quick mix and remix action. — **Construction Machinery Co., Waterloo, Iowa.**

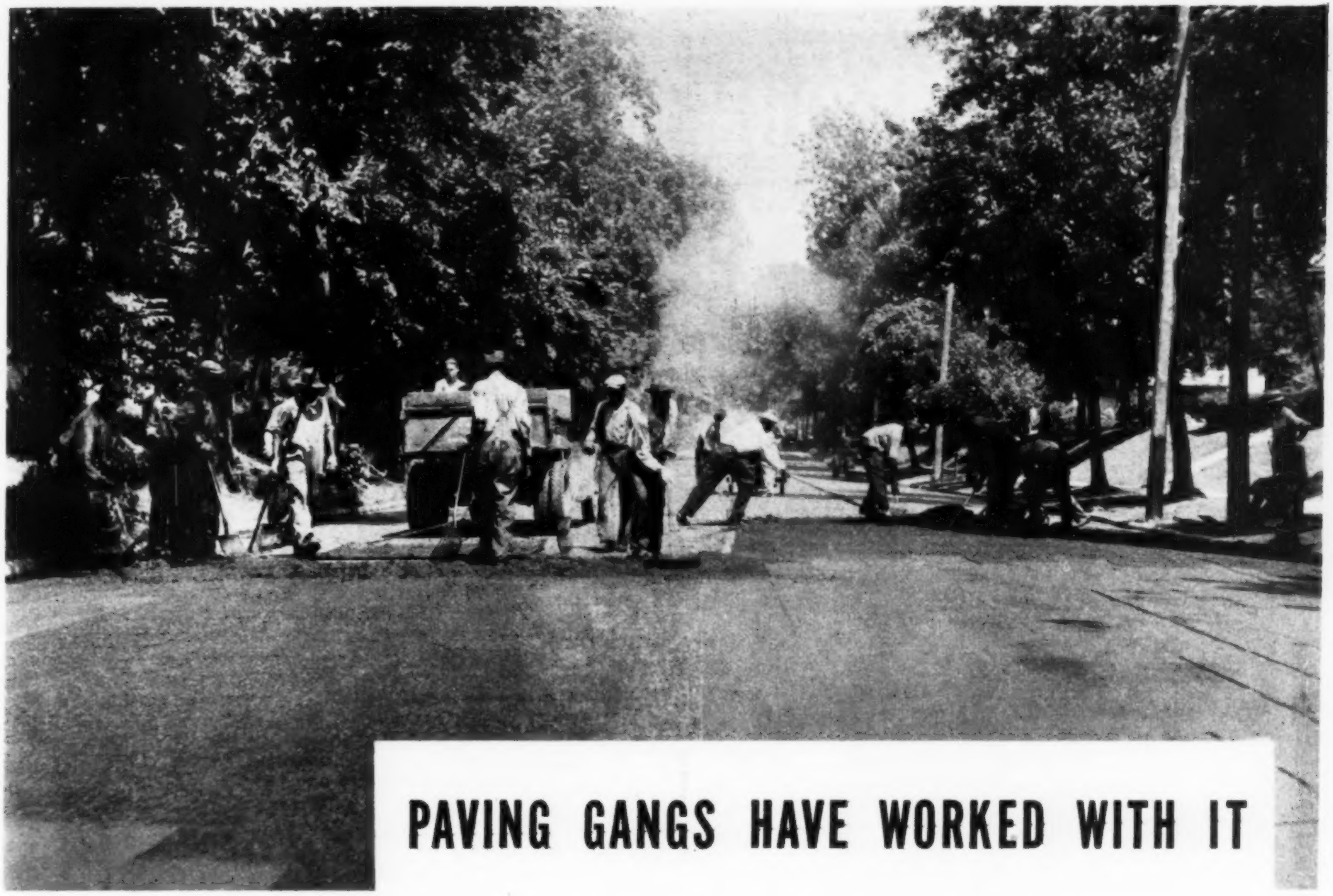


CONCRETE VIBRATOR, so-called "flexible shaft" type, has vibration rate of 4,200 per minute to give greatest amplitude, with higher speeds attainable through change in driving pulley ratio. Vibrator heads of alloy steel with abrasion resisting ribs welded on points. Internal rotors fully incased and mounted on double ball bearings with dirt-excluding seal and watertight entrance of drive section.

All driving sections interchangeable. Driven by gasoline engines or electric motors. Engines provide power by adequate bore and stroke instead of by excessive speed. Low engine speed, 2,200 r.p.m., assures long life, low maintenance cost and steady running. Full releasing disk clutches enable operator to stop work without shutting off engine, especially valuable in grinding and hammering. Sensitive governors maintain vibration frequency. Similar advantages are obtained by use of electric motor driven outfits which are furnished for line current or generator sets. Both engine and motor units mounted on swivel bases with convenient carrying handles; also mounted on wheelbarrow chassis. — **White Mfg. Co., 1227 W. Beardsley Ave., Elkhart, Ind.**

BALL-BEARING ELECTRIC DRILL redesigned to combine ample power, compactness, and lightweight with adaptability to close-corner work. Chuck spindle mounted at right angles to motor, reducing overall working length of tool to 4½ in. Motor housing dimensions reduced to minimum, enabling operator

to grasp drill firmly and requiring no extra handle. Cool motor operation assured by deep vents cast in gear head providing for free passage of air even when in use. Tapered end of gear head extends over chuck, protecting operator's fingers. Ball-bearing equipped throughout. Universal motor operates on a.c. or d.c. current. Removable insulated cap provides easy access to brushes. Two models: ¼-in. drill, capacity in steel, ¼ in.; in hardwood, ½ in.; speed, no-load, 2,500 r.p.m.; full load, 1,600 r.p.m.; 3/16-in. drill, capacity in steel, 3/16 in.; in hardwood, 5/16 in.; speed, no-load, 3,700 r.p.m.; full load, 2,300 r.p.m. Weight, 3½ lb. Overall length, 4½ in. in direction of chuck spindle; 7¾ in. in direction of motor. — **The Black & Decker Mfg. Co., Towson, Md.**



PAVING GANGS HAVE WORKED WITH IT A THIRD OF A CENTURY

Paving gangs have been turning out smooth, easy-riding TEXACO Asphalt pavements for approximately 33 years. These pavements today serve most of the largest cities east of the Rockies and many hundred smaller cities.

Machine-spreading gradually has been replacing gangs of shovelers and rakers. But whether they are using mechanical or hand-spreading methods, paving contractors today appreciate fully what TEXACO Asphalt's 33-year background means in quality of product, extent of resources and dependability of service.

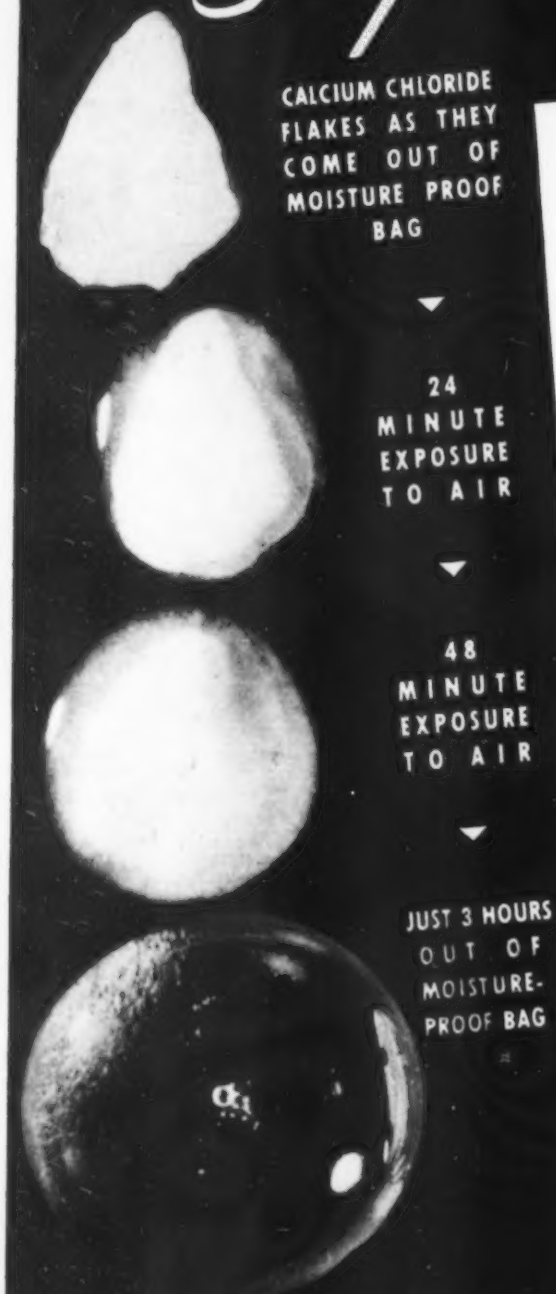
TEXACO ASPHALT

THE TEXAS COMPANY, Asphalt Sales Department

135 East 42d Street, New York City

Chicago, Cleveland, Kansas City, Houston, Dallas, Buffalo, Philadelphia, Richmond, Boston, Jacksonville

THIRSTY CALCIUM CHLORIDE FLAKES *Stop* THE DUST NUISANCE



MOST street and road officials know that calcium chloride binds road surfaces with moisture—that it prevents dust and aids compaction of surface materials.

Many, however, have never observed this moisture-absorbing, self-liquefying process in action. So we show, at the left, many times magnified, just how a flake of calcium chloride does its work. Each tiny flake attracts and holds for months, several times its own weight in water. The average season's requirement of two applications, 1½ and ½ pound per square yard, contains in its 2 pounds about 28,400 flakes—28,400 of these drops of moisture for every square yard of surface. Each of these drops extends its binding film around hundreds of particles of fine binder soil, which, in turn, holds coarser gravel and stone in a vise-like grip. So it is the cleanest, most effective dustlayer known.

Actually Pays for Itself In Maintenance Savings

Dustlaying and road surface consolidation with calcium chloride is not a luxury, though it seems mighty luxurious to dust covered residents and motorists. It is, in fact, a real economy through its saving of surface material and its reduction in maintenance cost.

Dustproofing of road surfaces with calcium chloride is only the beginning of its benefit in road improvement. By adding either fine binder soils or coarser aggregates needed to bring necessary stability into the soil composition of your roads, you can build up layer after layer, year after year, the finest dustless roads it is possible to build without expensive paved surfacing.

Several states, many counties and thousands of townships, villages and cities maintain their gravel, stone and shell roads with calcium chloride. You can do it too. Just write for literature.

CALCIUM CHLORIDE ASSOCIATION
4145 Penobscot Building, Detroit

FREE SAMPLE *for observation mailed on request.*

TURN YOUR "BAD BRIDGES" INTO GOOD ONES

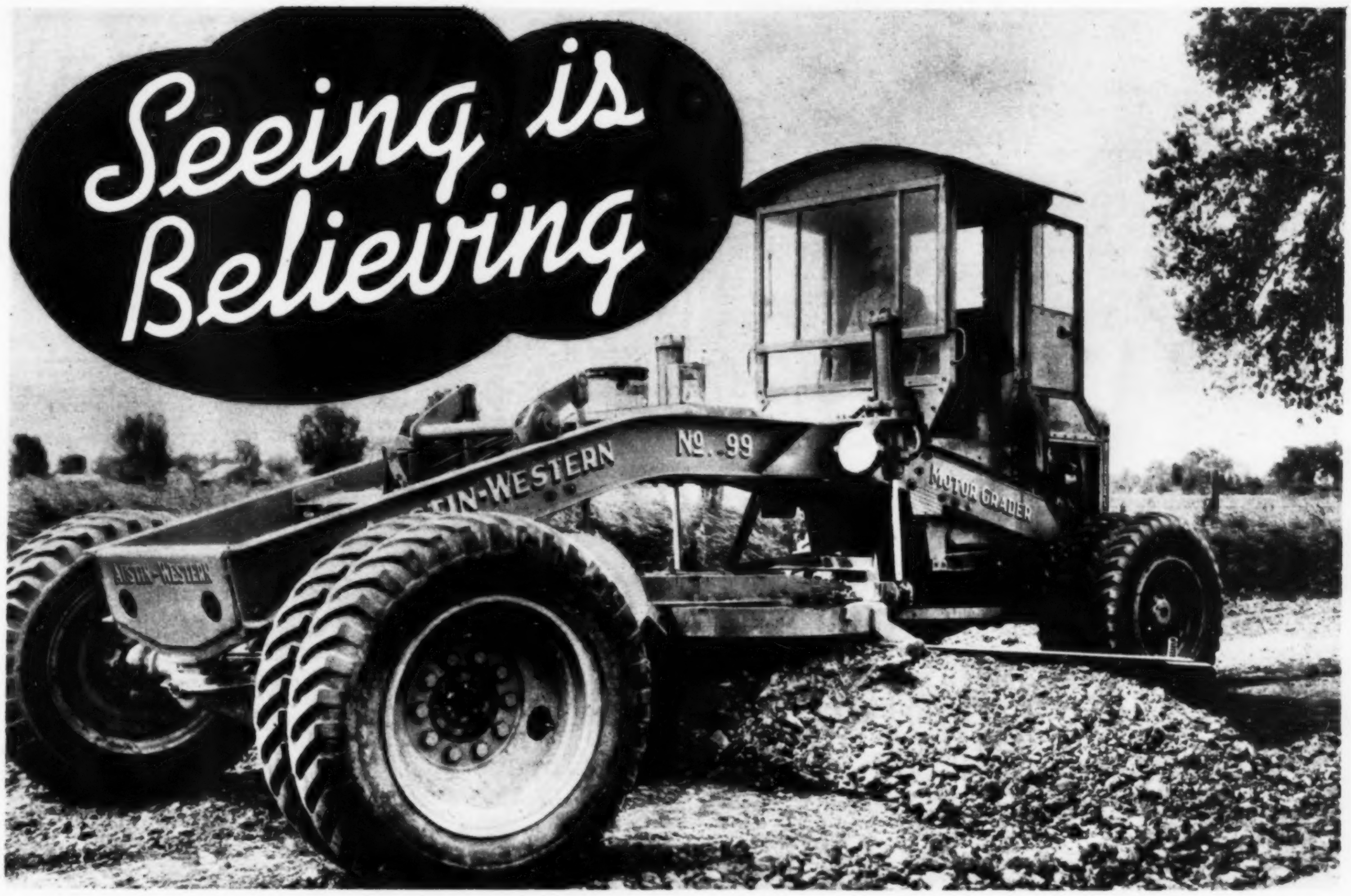
"Before" and "after" views showing a rickety old bridge replaced by a 25-foot span Armco Multi Plate arch.

START NOW on a definite program to make all your small bridges *as safe and attractive* as your roads. You'll be surprised how quickly and economically these needed improvements can be made with Armco Multi- Plate. • Designing with these heavy corrugated iron plates, you can widen or replace an average small bridge *in a few days* without interrupting traffic. No special equipment is required for erection. And once the earth backfill is placed you have a sturdy, low-cost bridge that should last a lifetime without upkeep or repairs. • Call in an Armco representative real soon and let him show you how little it will cost to "turn *your* bad bridges into good ones." Armco Culvert Manufacturers Association, 703 Curtis Street, Middletown, Ohio.

MULTI ARMCO PLATE

ARMCO MULTI PLATE

A PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS



● It's hard to realize the outstanding advantages of the A-W 4-Wheel Drive, 4-Wheel Steer "99" Motor Grader . . . the significance of its amazing traction, manueverability and economical performance. Until you've seen the "99" in action, it just doesn't seem possible that a motor grader can do so many jobs . . . do them so well, and so fast.

So we urge you to see a "99" put through its paces . . . on jobs and under conditions that you know any conventional motor grader is incapable of handling. Watch the "99" move heavier loads and move them farther. Ask the operator to swing it around a sharp turn without a stop . . . to shift a full load without changing the blade angle, and without gouging or wasting. Or, name your own tests. The evidence of your own eyes will demonstrate conclusively that even our most enthusiastic promises for the "99" actually fall short of its performance . . . that this extra power and ease of handling makes the hard jobs easy and day-today jobs cost less than ever before.

THE AUSTIN-WESTERN ROAD MACHINERY CO.
AURORA, ILLINOIS

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MOTOR "99" GRADER

THE AUSTIN-WESTERN ROAD MACHINERY CO.
1814 Barrows Street, Aurora, Ill.
Please send full information on the new "99" Motor Grader.
Also on machines checked:

- ☐ Blade Grader
- ☐ ½-Yd. Badger Shovel
- ☐ Roll-A-Plane
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PERFORMANCE *that pays* DIVIDENDS

GRANFIELD, FARRAR & CARLIN

Member Builders' Exchange

TELEPHONE

SAN FRANCISCO, CALIF

May 12, 1938

Emsco Derrick & Equipment Co
6701 South Alameda Street
Los Angeles, Calif

Gentlemen:-

We have had the G-L-T Hoist in service for a period in excess of 800 hours.

The hoist was mounted on an RD-8 Caterpillar Tractor used in conjunction with a scarifier and with Carry-alls of 12, 14, and 9 cubic yard capacity.

During this period of over 800 hours it was not necessary to perform any mechanical work on this unit. At the present date this hoist shows no noticeable abrasion and wear on any of the working parts, including the clutch and brake bands.

In reference to use and wear of and on cable, you may be advised that our records show this hoist to be 200% superior to any power unit we have used.

To use the vernacular of the operator of the tractor on which this unit was mounted, " It is a Cat-Skinners dream".

Yours respectfully,

Granfield, Farrar & Carlin

By John Carlin

1,000 hours continuous service with no time out for repairs or adjustments of any character.

EMSCO — EMSCO EQUIPMENT — FABRICATED STEEL PRODUCTS

Note these features

LARGE DRUM DIAMETER—11¼"—permits cable to lay on drum with less coiling tension, thereby reducing cable wear to minimum.

BRAKES and CLUTCHES — all on outside eliminating necessity of dissembling hoist to adjust or reline. All brake and clutch bands fully interchangeable.

FAIR LEAD — with greater sleuing angle — operates at wide angles—assures even wrapping of cable.

LARGER CAPACITY—built for the heaviest road building equipment manufactured — will perform the heaviest work under the severest conditions without the usual hazards and heavy upkeep.

CLUTCH and BRAKE BANDS—provided with extra large surfaces—will not heat up under the severest service.

CLUTCH and BRAKE ADJUSTMENTS—are identical in every respect—stay put when adjusted.

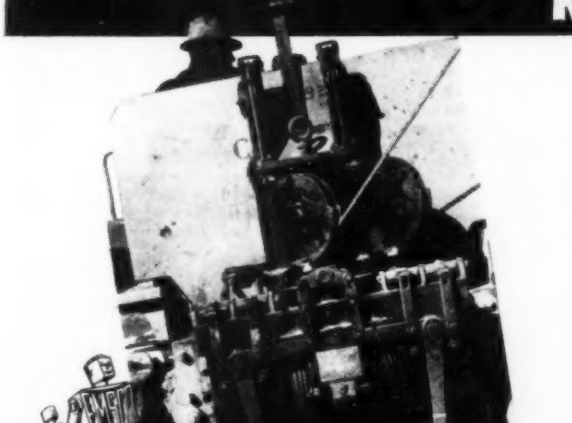
ALL GEARS—run in oil in dust proof housings. Only three oil seals required on double drum type, and two on single drum.

LUBRICATION—at one point. Uses oil of same quality and viscosity as rear end transmission of tractor.

SINGLE and DOUBLE DRUM and FOUR DRUM—with single and double lever control — for all large sizes of standard tractors.

EMSCO HOISTS

MODEL G-L-T



When this letter was written the hoist had 800 hours of continuous service to its credit. At this writing the record has been increased to 1,000 hours—and the Emsco Hoist is still operating with no shutdowns, indicating it will save its cost every few months.

The service is hard—the going is tough. And the Emsco Model "G-L-T" is just as tough. It has operated continuously without any cost whatever and with a considerable saving in cable expense. It has handled loads that other hoists could not handle.

That is the kind of service that pays dividends—enables the contractor to do big jobs fast, safely, and at a profit.

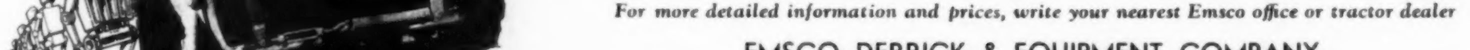
Emsco Hoists can be purchased on time payment plan with monthly payments only slightly in excess of monthly maintenance costs on many hoists.

Available for following tractors: Cletrac FD & FG, DD, DG, and DDH; Allis-Chalmers L & LO, S & SO, K & KO; Caterpillar RD8, RD7 and RD6; International TD40 and T40.

For more detailed information and prices, write your nearest Emsco office or tractor dealer

EMSCO DERRICK & EQUIPMENT COMPANY

General Offices & Main Plant: 6701-7101 South Alameda Street, Los Angeles, California



Emsco Trailbuilder on International Tractor — Emsco Bulldozer Mounted on Cletrac Tractor — Emsco Standard Model "EH" Double Drum Hoist — Emsco Cable Controlled Ripper — Emsco Scraper

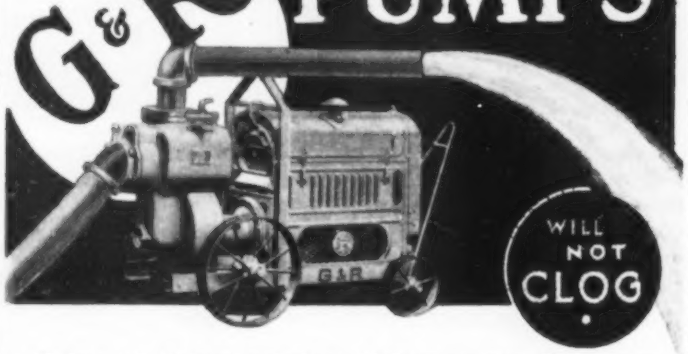
Extra PRODUCTION AT HIS FINGERTIPS!

● Greater profits are yours when production increases. Operators step up hourly out-put with the Air-Controlled Michigan Truck Shovel-Crane—do it faster, more efficiently. Air-controls, high speed and truck economy enable Michigan users to widen their range of profitable operations at minimum investment.

Write for "Bulletins CM & CM2"

MICHIGAN POWER SHOVEL Co BENTON HARBOR, MICHIGAN, U.S.A.

G&R PUMPS



***Claims* of fastest priming, highest suction lift, more gallons per minute, etc., *do not pump water.* On the job, the pump must do its own talking, and with dirty water, many a pump is inclined to stutter—and stop.**

Let G & R Pumps tell you their own story on any job. They will deliver as much, and usually more, water *under any condition,* than any other pump. We will ship you one and let you be the judge.

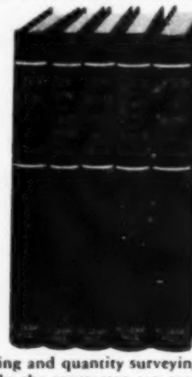
Remember this about G & R Pumps — THEY WILL NOT CLOG — THEY ASK NO TIME OUT. Play safe! Try a G & R Self-priming Centrifugal before you buy any pump this year.

Distributors in 100 principal cities are ready to make prompt delivery of the G & R Pumps you need.

The Most DEPENDABLE Pump for The Least Money

THE GORMAN-RUPP CO. Mansfield, Ohio

Practical facts on every phase of building construction!



HERE is a Library of books that are packed to the covers with the best plans and methods for speeding up production, saving materials and labor, and cutting costs. These six books cover every phase of practical construction work from estimating building costs to the selling of construction service — from plan reading and quantity surveying to practical job management. With the aid of these books the contractor can get business in these dull times by learning how to make savings, and through them being able to make lower bids. The construction superintendent can learn how to keep costs down, which insures his job these days.

The Dingman Building Contractors' Library

Each one of the volumes in this set is a complete handbook on some important subject. Sturdily bound and pocket size, it will go right "on the job" with you for immediate consultation.

Practical data is given on analyzing a construction job into its component parts — estimating the costs of labor, haulage, equipment, materials, etc. — plan reading and determining quantities from specifications — personnel management — successful supervision of every building operation — efficient and economical business methods — office procedure such as accounting, banking, purchasing, etc. — advertising and selling methods for contracting service — and a complete data book of tables, forms and calculations most frequently used by the builder.

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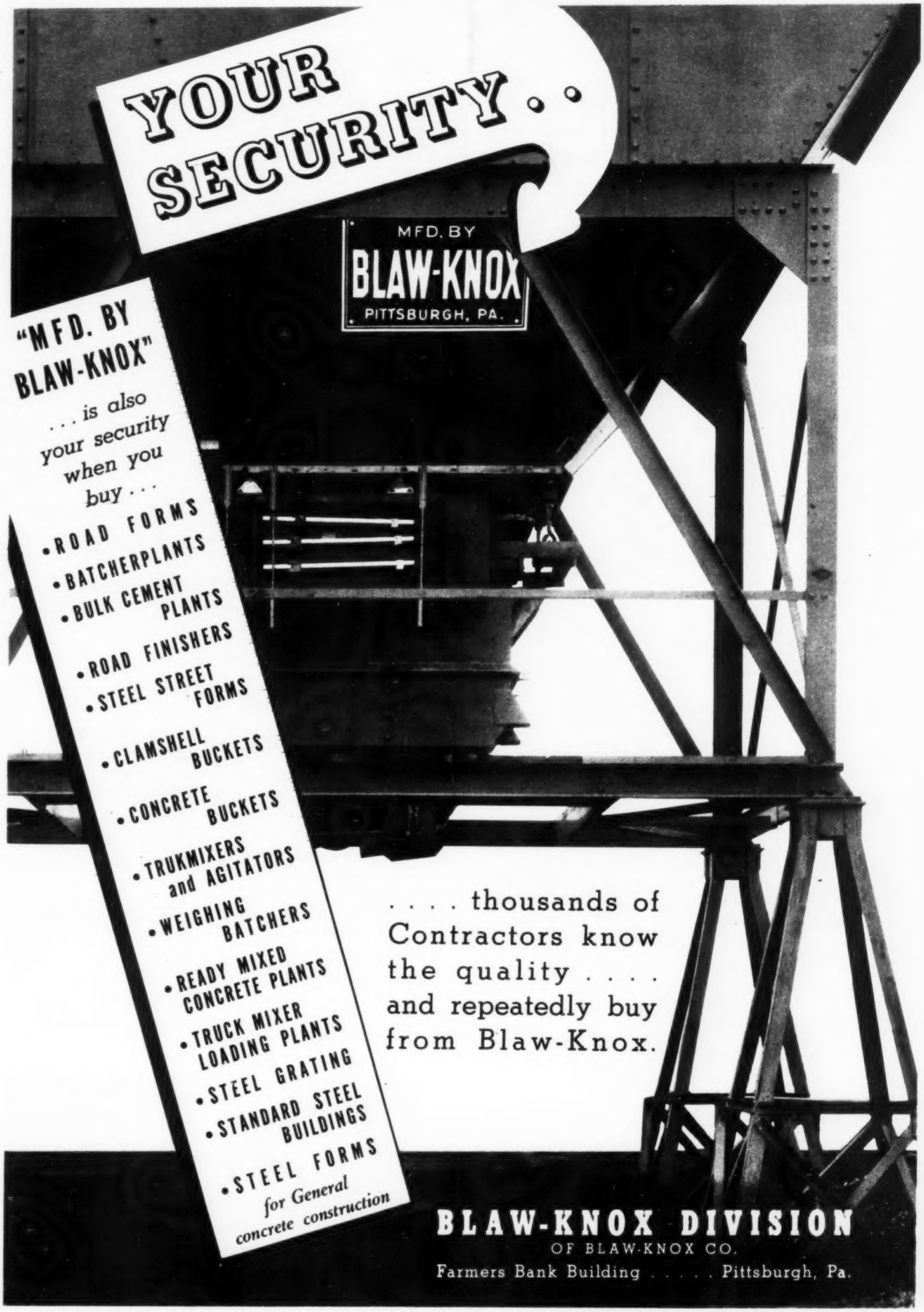
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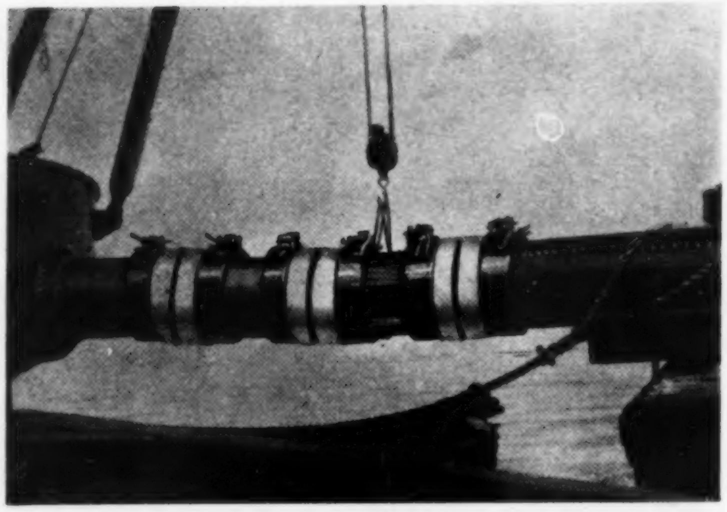


It doesn't take a "Muscle Man" to operate a CONTINENTAL

It's as easy as turning on a faucet!

You don't have to be a circus strong man to operate a Continental. As one operator said: "It's as easy as turning on a faucet." Operating a Continental quickly becomes mechanical — just like driving a car. Operators do not become fatigued — at the end of the day they're still moving dirt with zest long after the boys on the buggies that require brawn to operate are fagged out.

That's only one reason operators like them — they like the speed with which Continentals dig, load and haul; cutting out sand, gumbo, wet sticky clay, shot rock and imbedded roots in layers from wafer-thin to a foot thick, and rolling it up into the bucket in such a way that the last material loaded isn't held back by what's already in the bucket.

They like the way Continentals back-dump like a truck over a bank, into water, against a retaining wall, in windrows or stock piles; and they spread, grade and level, too; spotting the load or any fraction of it just where it's wanted. They load full, dump fast, turn short and back easy. They eliminate bulldozing.

They're easy to operate whether it's a 4, 5, 7 or 10 yd. Continental mounted on low pressure tires or crawlers, because they all use the same simple, rugged, dependable BE-GE Hydraulic Pump Unit.

Mrs. Tractor Operator likes Continentals best, too, because the Mister doesn't come home all grumpy and worn out!

Continentals are sold by Allis-Chalmers dealers everywhere.

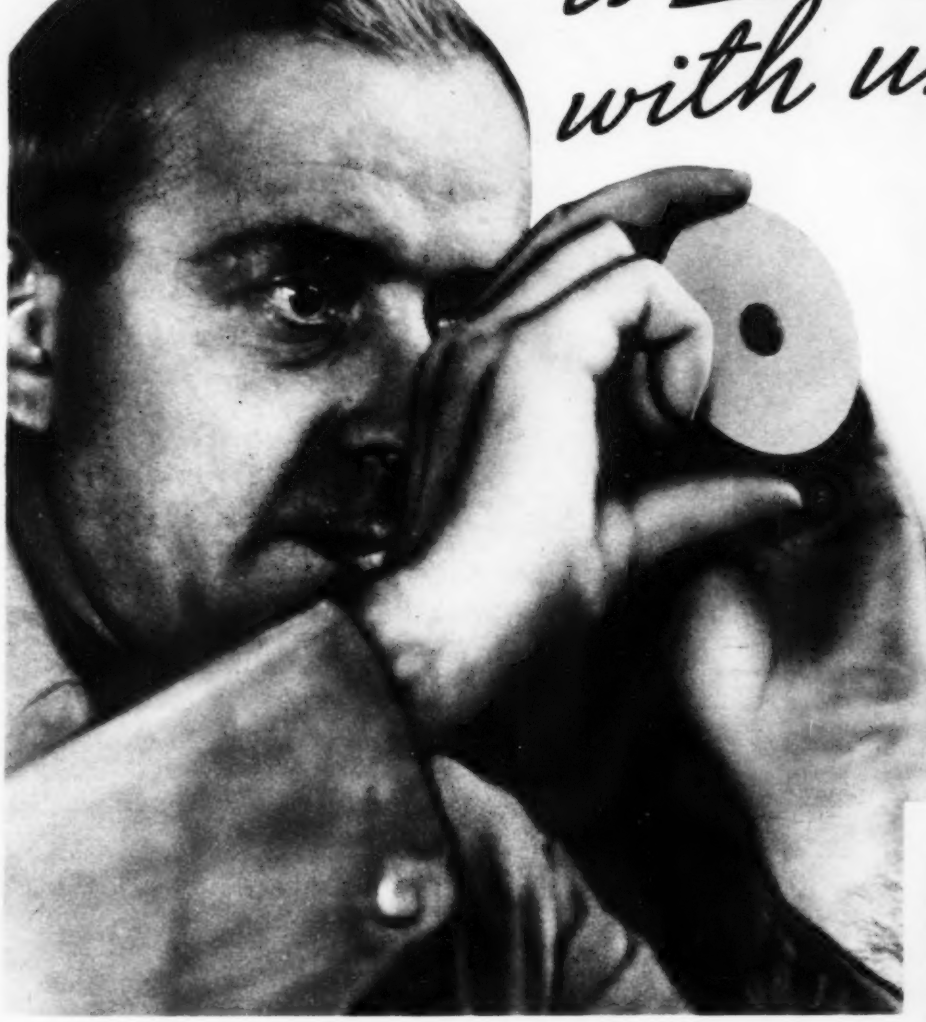
CONTINENTAL ROLL & STEEL FOUNDRY COMPANY
Tractor Equipment Division
14370 Railroad Avenue
East Chicago, Indiana

Dumps right over the brink, out of the way of the wheels—no need for bulldozing. Right: Cleaning out a cave-in. Continentals dig and load just as speedy going up or down hill as on level ground.

CONTINENTAL WAGON SCRAPERS

MAKING WIRE ROPE

is not a sideline with us... IT'S OUR MAIN BUSINESS!



Rene Vernezze, Specialist, looks critically at a Tungsten-Carbide die. "All dies polished at Macwhyte," he says, "must be accurate to 1/1000-th of an inch."

The Macwhyte Company has stuck to one job—specializing in the manufacture of high quality wire and wire rope.

Wire rope specialists supervise *every* step carefully from start to finish. On the job of polishing dies for the cold-drawing of wire, for example, specialists make sure the finished die is accurate to 1/1000-th of an inch!

The slightest variation in the diameter of a single piece of wire would cut down the service life of the rope. Macwhyte protects its users against this possibility by constant supervision of die polishing and by daily checks of dies in use.

This same care and accuracy is characteristic of all Macwhyte operations, from laboratory research to finished product. That's why when you buy Macwhyte Whyte Strand, you can expect *better* wire rope service and *longer* wire rope life.

LOOK FOR THE

Whyte Strand

MACWHYTE WHYTE STRAND IS *BETTER* BECAUSE IT'S MADE BY SPECIALISTS

MACWHYTE COMPANY

KENOSHA, WISCONSIN

Manufacturers of wire rope and braided wire rope slings.

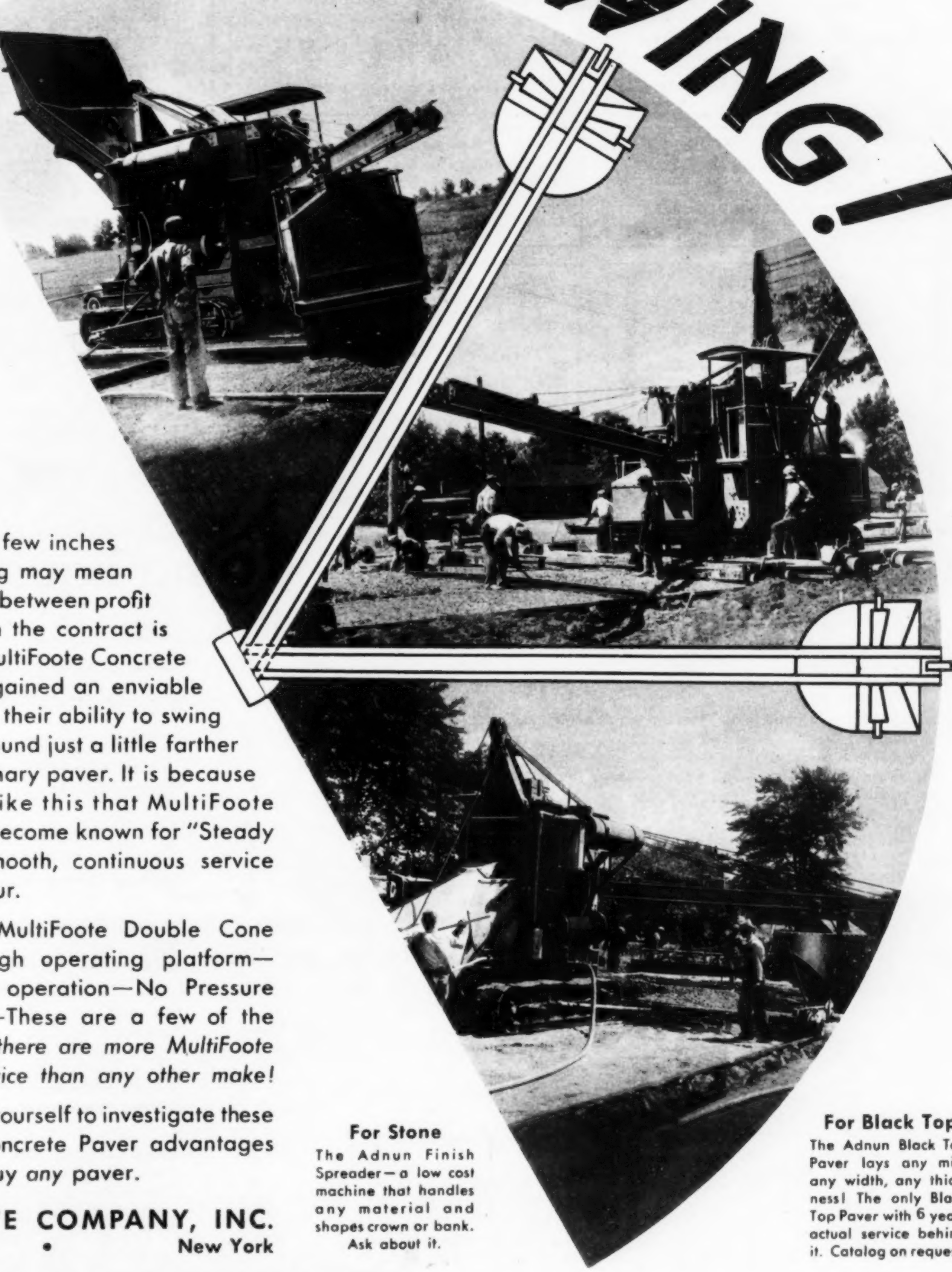
Distributors and stock throughout the U. S. A. for quick service.

NO. 373A

MACWHYTE

Whyte Strand - PRE *formed*

THE WIRE ROPE WITH THE INTERNAL LUBRICATION



CONSTRUCTION Methods and Equipment

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